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Essays on Battle Clusters in Internal Armed Conflicts and Insurgencies: Concept, Causes and Consequences

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DEDICATION

This dissertation is gratefully dedicated to my father Guo-Hung Liu, my mother Chiu-hsiang Liao, and my beloved wife Jasmine Hsu. Thank you for the support in all these years.

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ABSTRACT

With the purpose to re-conceptualize the intensity of internal armed conflicts, I argue that the characteristics such as location, scale and duration of “major battlefields,” i.e. the spatio-temporal clusters of combat events are important in the evaluation of impact of modern civil wars and insurgencies. I start with elaborating and constructing a new concept of conflict magnitude with battle clusters using up-to-date geo-referenced data and spatial statistic methods. In the second article, I first explain the location and duration of major battlefields. The findings indicate that an area with multiple non-state armed groups (NSAGs) is more likely to become main battlefields in conflict. Besides, NSAG's organizational structure as well as their “strength indicators” - transnationality, alliance with governments and the size of their areas of operation (AOs) - are also positively related to more and longer battle clusters in a place. In the third article, I find that the density and duration of major battlefields in civil wars contribute to the incidence and severity of terrorist events during and after the war. The more “condensed" a major battlefield is, i.e. there are more battle events occurring in the battlefield temporally or geographically, the more likely that terrorist events would take place during or after the conflict. In addition, the longer a place has been a major battlefield in the civil war, the more likely that there would be terrorism in that place. Finally, the condensed and prolonged major battlefields would also contribute to more casualties in terrorist events during or after the war.

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CHAPTER 1:

"CONCEPTUALIZING, MEASURING AND MAPPING THE INTENSITY OF CIVIL WARS USING SPATIAL TOOLS"

This research looks for another perspective on the measurement of intensity in civil wars other than using just battle deaths. Intensity of civil wars can be conceptualized spatially as the most possible/densest battle clusters. I argue that to construct a new intensity concept of civil war, we should start with measuring and locating the main battlefields in civil wars correctly. Using the size of battlefield as an indicator of intensity is not a totally new idea but has been paid less attention because it is difficult to measure battlefields in civil wars. To study where most intense battles occur may be able to answer some important questions in the study of civil wars. I begin by discussing the concepts of the Correlates of War (COW) project that are used to measure conflicts including civil wars. The static nature, state level of analysis of the conflict coding scheme and growing irrelevance of battle deaths are becoming questionable in the research on civil wars today. It not only limits our ways to conceptualize civil wars but also prevent us from asking more meaningful and important questions about civil wars. Next I introduce how current trends to disaggregate civil wars and the growing interests of political geographers in internal armed conflicts pave the way for another possibility of re-measuring civil wars from a different perspective. Then I discuss why measuring the location are especially important in civil wars today and what has been done by researchers on this topic. Following is a demonstration of a temporal-spatial clustering method with data from an ongoing location data coding project using visualization. Important data such as the size of main battlefields, total numbers of main battlefields, and the distance of main battlefields from other important locations such as the capital city and/or economic center/industrial bases are also generated. I conclude that with the help of new methodology and data projects, the efforts to re-conceptualizing measures in civil wars would not only enhance our understanding of civil wars but also benefit both the qualitative and quantitative studies.

1.1 THINKING BEYOND MEASURING CIVIL WARS SOLELY BY BATTLE DEATH

Battle death[1] is an important measure in the quantitative study of interstate and intrastate conflicts. Being the first to systematically categorized wars, Richardson (1960) lists wars by their logged numbers of casualties, i.e. magnitudes. In Singer and Small's Correlates of War (COW) Project (1972) three main indices--magnitude, severity and intensity--are used to measure interstate and intrastate conflicts. Among them, severity and intensity are measured with battle deaths (or battle-related deaths) (42). The severity of war is defined by total battle-related casualties. The intensity of war used to have three measures, which are the ratio of severity to (1) the duration of conflict per state ("nation month") (2) size of pre-war armed forces of each state and (3) pre-war population size of each state (53). For possible reliability issues and endogeneity problems, the second measure (BD/AF, the ratio of battle deaths to size of armed forces) is abandoned in Small and Singer's later definition (1982). Now the battle-deaths-based indicator of intensity has become an essential measure and category in major datasets.

[1] My conceptualization here is close to Lacina and Gleditsch (2005). Richardson (1960) and Singer and Small (1972) do not especially separate combatant deaths and battle-related civilian deaths in conflicts. Lacina and Gleditsch (2005) define battle-related deaths to be combatant and civilian deaths directly related to conflicts, excluding genocides or other "collateral damages."

In recent years, researchers begin to criticize the use of battle deaths as the dominant measure of war intensity in both interstate/internal conflicts. The first criticism is toward the narrow focus of traditional concept of intensity. Moore (2005) criticizes the COW as a "particularistic conceptualization" and argues that there are "many dimension of intensity of war (8)," which may produce productive answers for the study of war but are neglected in the COW measurement. Second, the validity and reliability can be an issue in the measuring of battle deaths (Lacina and Gleditsch, 2005). It is usually difficult to calculate and obtain the exact number of battle deaths in wars, especially modern civil wars.

An important incentive to re-examine the battle-death intensity measure comes from the change of war patterns since the end of WWII, especially in the post-Cold War era. First, the decline number of interstate wars and diminishing casualties in modern day interstate wars generally alter what we think of battle deaths. The number of battle deaths was used as a measurement of the human capital during the war (Klingberg, 1966). States in the past might have been more willing to sacrifice a great portion of soldiers for a possible victory than they would do today. States, however, are generally more sensitive to war-related death nowadays. Most leaders and politicians are trying hard to reduce war-related deaths; the use of precision weapons and the disappearance of unconditional bombing tactics such as those taken by Luftwaffe during the WWII in London are good examples. Since combatant deaths are never leading causes of death nowadays, then measuring the intensity of war by sheer numbers of battle death becomes problematic. Comparing deaths caused by wars and car accidents, Mueller (2004) argues that the former may not necessarily be more deadly than the latter. The example of Vietnam War shows that the probability for an American youth to be killed in Vietnam battlefield is approximately as the same as driving on the road (268-269). Interpersonal violence, according to O'Loughlin and Raleigh (2007), kills more than interstate and/or intrastate wars worldwide (493).

As civil wars become the dominant form of armed conflicts after the end of Cold War, the measurement based on battle deaths incurs other problems. For civil wars, civilians suffer much more than combatants in the war. According to Melander, Oberg and Hall (2006) and Sivard (1987), among the top 25 most lethal civil wars taking place after WWII, civilian casualties account for more than 65% in 17 wars fought. In the cases of India (1946-48; civilian deaths 800,000) and Uganda (1971-78; civilian deaths 300,000), the combatant casualties are even zero (16). Another widely cited statistics shows that 90% of battle-related deaths in recent wars are civilians, while the civilian casualties in WWII only accounts for 5% of total deaths (Lacina and Gleditsch, 2005, 146; Sivard, 1996). The main human life loss in internal armed conflicts are usually caused by politicide and genocide conducted during or after the war (Rummel, 1997; Harff, 2003). What is deemed "collateral damage" and indirect deaths in interstate wars actually constitute most human life loss in civil wars. Ghobarah, Huth and Russett (2003) also report that civil wars would destroy the public health system and then facilitate the communication and spread of diseases such as AIDS among the war-ridden countries. The long-lasting effect would continue after the end of war and claim human lives--most of whom are children under 14. Lacina and Gleditsch (2005) admit the difficulty to calculate the "real" human costs in civil wars and conclude that "[t]allying the cost of a war quickly defies straightforward accounting." Besides, internal armed conflicts (especially in Africa nowadays) also cause socio-economic problems such as environmental degradation, wildlife extinction and refugees or IDP (Internally Displaced Persons).

At the methodological level, the intensity measure also has some deficiencies. Battle death also serves as the cut-off criterion in COW (1,000 battle deaths per annum). This not only causes possible selection bias among the samples but also raises other research issues. For example, Sambanis (2004) argues that the rigid cut-off line of 1,000 annual battle death would have problematic operationalization and thus prevents researchers from studying escalation in civil wars (818). To solve this problem, Sambanis proposes for a relative measure (i.e. battle-related death per capita) and make up a set of coding criteria for these issues.

Another major research issue for current measure using battle deaths in relevant conflict databases is that for most of the time users cannot know how the severity or intensity of war evolves over time. In the original COW scheme, the unit of analysis is conflict and intensity of war is defined as severity (total battle deaths)/nation-month, i.e. the average battle deaths of the warring nation per month. The COW definition of intensity is a function of duration and casualties: shorter wars with a huge amount of battle deaths will be the most intense conflicts. The attempt to average out battle deaths in a specific war, however, may help cross-national comparisons, but we would never be able to “look into” the conflict to see different phases in the conflict process.

Lacina and Gleditsch (2005) attempt to create conflict-year data respectively within the frame of UCDP/PRIO, COW and Fearon and Laitin datasets. They update casualty data with new definition of battle death and break them down either in conflict-years or country-years. However, due to the inaccessibility to exact battle deaths data, many recordings are just the yearly average battle deaths, which are time-invariant[2]. This would create a problem for time-series models, because civil war (interstate war as well) is a dynamic process. The ferocity and locations of wars change as wars are fought in different stages, so that the intensity in the same war varies with places and time. For example, in the Chinese Civil War between Mao Tse-tung of the Chinese Communist Party and Chiang Kai-shek of the Nationalist Party from 1945-1949, the Three Campaigns in 1948--Liaoshen[3], Huaihai[4] and Pingjin[5]--are the most intense and crucial military engagements between the government and the rebels. After April 1949, the Communist forces (the rebels) crossed the Yangtze River and captured the capital Nanjing. From then on to the establishment of People's Republic of China in October 1949, there were actually sporadic fights because the Nationalist forces had basically given up resistance. However, in either COW or UCDP/PRIO data, it is difficult for users to tell the intensity of war by looking at battle deaths. On the contrary, the Chinese Civil War looks quite static and homogeneous rather than time-variant or spatially-variant.

1.2 THE EMERGING TREND TO DISAGGREGATE CIVIL WARS

Deficiencies that battle death has as the major (if not the only) indicator of war intensity are the symptom from the logic of studying all wars at the national level. Researchers use state as the level of analysis to study civil wars as they do interstate wars. This may be partly due to the fact that recently more and more students of international

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[2] For example, in the Uganda Civil War (1980-1986) on the COW list, Lacina and Gledistch (2005) average the total battle death by seven years (average=14685). There are yearly data which vary by years, but they only account for around 32.08% with the COW conflict-year data and 39% with the Fearon and Laitin dataset (of which the unit of analysis is country-year).

[3] During the fall of 1948 in Manchuria.

[4] Fall 1948-Spring 1949, in eastern China north of the Yangtze River.

[5] Fall 1948-Spring 1949, around the Peking (not yet the capital) and Tianjin.

conflict switch their interests to intrastate wars. During the Cold War, there was a lack of interests for political scientists and/or international relations (IR) researchers on civil wars. Few researches were either part of revolution studies, foreign policy analysis (Modelski, 1964) or as a strategy against the Soviet Union in the Cold War (Scott, 1964). The end of Cold War forced some former Sovietologists/Russian experts to shift their focus (David, 1997, 554), but the more important reason is the decline numbers of interstate wars after 1989 (Mueller, 2004). Civil wars also become the focus of economists of international development. The most prominent one is Paul Collier and his disciples and/or collaborators (Collier, 2007; Collier et al., 2003; 2004; Collier and Hoeffler, 1998; 2004; Collier and Sambanis, 2005). Their "greed and grievance" framework has influenced following researchers in civil war not only in attributes/variables (the greed factors are more important than the grievance factors), but also in methodological level. Many researchers use cross-national large-N econometric models to conceptualize and explain he inception and duration of intrastate wars (e.g. Collier and Hoeffler, 2004; Fearon and Laitin, 2003). This may explain the tendency that many researchers examine and analyze civil wars at the state level. The intention to generalize patterns in civil war studies has been criticized by some political scientists, among them many are comparativists. For example, Kalyvas (2008) argues that there is a lack of strong conceptual foundations in the study of intrastate wars today, while the econometric studies suffer from problems such as endogeneity, lack of micro-foundations and theoretical scopes (397). The result, according to Kalyvas, is the emergence of a new research program in civil wars: the micro-dynamic perspective. Consider the example that Russia is marked as a country having a civil war (with Chechnya rebels) going on in the country. However, this kind of categorization somehow "exaggerates" the influence of the conflict, because the effected area is mostly around Chechen (except terrorist attacks in Moscow or other civilian targets in Russia) (Gleditsch et al, 2002). The solution to this problem is to disaggregate civil war and locate where exactly the "war" take place.

Another important factor behind recent growing literature in disaggregating civil wars is from, not surprisingly, the trend for geographers to "turn to the local." The efforts and attempts to generalize have been questions by some researchers, and they try to focus on some local models that would fit in different contexts. Among those researchers who call for change in methodology, many of them are political geographers (for example, see O'Loughlin and Witmer, 2005). Starr (2003) points out that one major methodological challenge facing researchers in international politics today is the agent-structure problem, i.e. "how to get at the relationship between an entity and an environment (15)." O'Loughlin and Witmer (2005) respond to Starr by advocating that political scientists not only have to "take geography seriously" but also "collect more disaggregated data on civil wars (1)." O'Loughlin and Raleigh (2007) also propose that "geography is not only about space….but is also about 'place'," defined as "the unique combination of circumstances for each region that produces the cultural-political mosaic across the world's continents (494)." This trend prompts geographers to develop and apply more locally-emphasized statistic tools such as the geographically-weighted regression (GWR) [6]. The identification of "hot spots," locations and clusters also creates more disaggregated datasets (Braithwaite, 2006), as new statistical methods and computer software are

[6] See Fotheringham, A.S., Brunsdon, C., and Charlton, M.E. 2002. *Geographically Weighted Regression: The Analysis of Spatially Varying Relationships*. Chichester, UK: Wiley.

invented (such as LISA-Local Indicators of Spatial Association[7] and GeoDa[8]). Recent development in computer hardware and geographic information system (GIS) also makes mapping and using many kinds of local data much easier.

Buhaug and Lujala (2005) discuss local characteristics and factors causing civil wars. Factors such as terrain, natural resources, population or ethnicity can vary in different areas of a country. To study civil wars only at the national level, they argue, would eliminate the variation and have incorrect or insignificant results (404). They argue that intrastate wars are "sub-national events" by definition, and the combat areas rarely include the whole country territories. Also, the study on borders, economic performance and neighboring civil wars needs to pay attention to sub-national location, because the country-level aggregated data may conceal important information of distance and location and yield wrong results (403).

1.3 WHY LOCATION IS AN IMPORTANT MEASURE IN CIVIL WARS

In the study of armed conflicts, the location of war can reveal important information. First, locations reveal willingness of the warring parties in the civil conflict, especially the willingness of the rebel side. Gleditsch et al (2002) classify civil wars into two kinds: governmental disputes and territorial disputes. In the former, rebels aim at "the type of political system, the replacement of the central government, or the change of its composition," while in the latter the goal is about secession or autonomy from the central government. Different objectives and expectations would result in different strategies and tactics. Buhaug (2006) argues that in governmental conflicts combats tend to take place and concentrate at or around the capital, but not in territorial disputes because rebels tend

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[7] See Luc Anselin. 1995. "Local Indicators of Spatial Association-LISA." *Geographical Analysis* 27:2:93-115.

[8] See The GeoDa Center main page: http://geodacenter.asu.edu/.

to deem defending their autonomy as the priority.

Second, some other characteristics of civil wars can also be shown by conflict locations, e.g. the relative capability of the government and the rebels. In the case of American Civil War (1861-1865), most of 384 principal battles are in the South: 126 in Virginia, 38 in Tennessee, 29 in Missouri, 28 in Georgia, 23 in Louisiana, 20 in North Carolina, 17 in Arkansas, and 16 in Mississippi (Kennedy, 1998, 458). Only three counties north of the Mason-Dixon Line have been battlefields: York and Adams County (where Gettysburg is in) in PA and Columbiana County in Ohio (Ibid, 451-52 Map). The distribution of battlefields in the Civil War shows the superior military and industrial capability of the Union, which finally won the war over the Confederacy. The failure for the South to defend its home-bases is the proof of military inferiority.

For contemporary civil wars, geographically different patterns in the conflict process are found in some case studies. It is important that we take into consideration the "spatial heterogeneity" in civil wars. According to Lowi (2005), in the Algerian Civil War conflicts concentrated in urban areas because rebels aimed to capture the state. The war spread to the west part of Algeria after 1994 but never to the oil-rich south, where the government army had preponderance of power (237-238). Another study by Kimenyi and Ndung'u (2005) about the Kenyan ethnic violence also shows that internal conflicts can be limited in some areas in a country rather than spread across it territory (150-152). On the other hand, geography, as an important independent variable, might also affect military success and recruitment in civil war. Local geography can offer sanctuaries for rebels and reduce the probability of being attacked and captured by the government forces. Geography also helps a rebel group to recruit separately from the government or other rebel groups (Gates, 2002).

Location of conflicts address to some other important topics that attract more attention in the current study of intrastate wars, such as civilian casualties, refugees, genocides, disease spread, and post-war recovery, etc. Armed conflicts and these issues are spatially correlated. The number of civilians killed or wounded is expected to be higher than other places in the country at war. War brings disasters to local population. People who live in or near the battlefield would bear the largest impact of war. Refugees and interally displaced persons (IDPs) is another salient issue. A recent example is the North Kivu Province in Democratic Republic of Congo (DRC), which is the main battlefield of the Second Congo War (1998-2003) and the Kivu Conflict (2004-present). Laurent Nkunda, the recently-arrested rebel leader of DRC, led an offensive in the North Kivu region in 2008 and caused 250,000 refugees to flee from the area, and the number of IDPs in the province has reached 850,000 ("DR Congo seeks Nkunda extradition"). Kalyvas (2006) studies genocide in civil wars using the Greek Civil War (1946-49) data recorded at the village level. He argues that warring groups' local control is the key variable to explain political violence/killings. Thus, identification of major battlefields is essential to micro-level research on political killings. Melander and Oberg (2007) also report that forced migration in civil wars is determined by the geographical size of war rather than the battle-deaths-based measure of intensity.

Location of internal wars also has great influences on the contagion of diseases. Wars help infectious diseases such as cholera, dysentery, plague, smallpox, typhoid and louse-borne typhus fever to spread. As the pioneer researcher on war and epidemics, German physician Friedrich Prinzing indicates, those infectious diseases "usually followed at the heels of belligerent armies (cited from Smallman-Raynor and Cliff, 2004, 35).” Mobilization and concentration of troops in the battlefield increase the probability of infection and spread of diseases. Poor hygiene and nutrition brought by wars such as the destruction of health infrastructure, poor management of bodies and internment and famine all help the development of epidemics; population movements in large scale spread diseases. In the Ugandan, Burundian and Rwandan Civil Wars, epidemics such as AIDS, louse-borne typhus and cholera spread with war and caused large amount of death (Smallman-Raynor and Cliff, 2004, 42). Examining the relationship between the spread of enteric fever, smallpox and yellow fever in Cuba during the Cuba Insurrection from 1895 to 1898, Smallman-Raynor and Cliff (1999) find that those infectious diseases followed the route of insurgents and spread across the island. Proctor et al. (2005) discover significant clusters of chronic multi-symptom illness (CMI) cases in some specific areas in the Gulf War of 1991, suggesting that potential exposure to some area-specific hazardous materials or deployment may relate to higher incidence rate of CMI.

Havoc that wars bring to local environment and ecological system can cause disastrous problems. Weapons such as the Agent Orange and pesticides used in Vietnam War caused serious deforestation in local areas. In the first Gulf War during 1990-1991, the Iraqi Army blew up 730 oil wells. Some oil wells gushed out large amount of crude oil and brought ecological disasters for local fauna and environment (Stead, 1997). Misfortunes that civil wars bring to a country will not be even. Battlefields and the neighboring areas would suffer more economically than other unaffected areas. Means of productions such as plants, factories, tools and machines tend to fall prey to rebels, which would delay the post-conflict recovery. Battles would destroy schools and bring educational difficulties for the region. The battlefield trauma would also cause some physical and psychological problems for people in the area. Weapons left in the battlefields such as mines, unexploded mortars and sub-munitions from cluster bombs would continue kill and maim people in the area after the conflict ends (Pasha, 2008).

1.4 THE LOCATION-BASED CONCEPT OF INTENSITY IN CIVIL WARS

More attention to the location of wars is definitely needed. The spatial aspect of war, however, has been long ignored in the study of wars in political science. It is obvious that distance (i.e. geographic distance), as an important concept in geography, has been used to measure interactions among states, while contiguity (can be measured in number or length of shared borders) is also incorporated in many econometric models. However, these two indicators also suffer from temporal invariance, while at the same time some other important concepts in spatial measure, such as area, location and direction, do not receive much attention.

In fact, the idea to measure interstate or intrastate wars in the spatial scale is not totally unfamiliar to political scientists. Singer and Small (1972) talk about measuring the magnitude of conflicts in "spatial" dimension. Calculating the size of battlefields and the number of battles are both considered possible measurement of war magnitude (43). Moore (2005) also mentions several concepts that can be used to measure the intensity of war; one of them is "size of territory under dispute (8)."

However, there are difficulties in measuring battlefields. First is about location: how can we know where the "war" is? The second one is about scope: how do we measure how large the war is geographically? Without answering these questions, it is impossible to calculate the area of territories suffering from wars. Many researchers attempt to locate civil wars using the "core-periphery" concept, which assumes that the state occupies the "core" of the country while dissatisfied rebel groups attempt to attack from the periphery. Similar concepts can be found both in research applying Kenneth Boulding's viability model/Loss-of-Strength-Gradient (LSG) concept (1962) and relevant research in comparative politics/African politics such as Herbst (2000) and Boone (2003). Boulding's model has been used and modified by many researchers (O'Sullivan, 1983; Buhaug, 2007; Weidmann et al, 2006). In LSG, each actor's strength reaches its peak at the geographical center (*home strength*), and it declines as it travels farther from home. The projection of power resembles an umbrella with the central tube as the home strength and declining spokes as diminishing powers. The point where two umbrellas intersect with each other is the "boundary" and where conflicts are most likely to erupt (Boulding, 1962, 230-31). Boulding's model suggests that different combinations of home strength and distance would put conflicts in different places on the map. Based on the core-periphery concept, Buhaug and Gates (2002) define conflict zone as the administrative area as the "area controlled by rebels" or "area affected by the conflict (424, footnote 10)." A scope of conflict is the smallest circle that encloses the whole zone of conflict, and the distance between the center of conflict scope and capital is measured (See Figure 1.1). Another measurement, the relative scope, is created by defining the conflict area as proportion of the total land area (424).

Buhaug and Gates not only locate the war but also attempt to define how large the conflict is. Raleigh et al (2006) go further and compile *Conflict Sites 1946-2005* datasets with similar concepts. This dataset add geo-referenced variables such as latitude/longitude of the conflict site (using the decimal degree) and the radius of scope to 231 conflicts in the UCDP/PRIO conflict dataset. What differs is that in Raleigh et al (2006) the site where conflict took place is used as the center point, while Buhaug and Gates (2002) use the center of rebel-controlled area as the anchor point. Each conflict in the *Conflict Sites 1946-2005* dataset is disaggregated by year. However, almost every conflict is recorded to have the same conflict center point, and radii of scopes seldom change with time.

There are several issues of conceptualization in Buhaug and Gates' concept of conflict zone (2002). First, defining conflict zone as "area controlled by rebels" can be problematic, because rebel-controlled areas are not necessarily "at war." In some cases of intrastate wars, government forces were not able to carry out effective and enduring attacks to the rebel bases. If rebel groups can exert effective control, the frequency of battles in the rebel-controlled area is even lower than that in or around the capital. Second, if the rebel-controlled region is large and only a part of it has ongoing conflicts, it would be conceptually problematic to define the whole area as a "conflict zone." Another conceptual issue is that in most of the battlefield definition, time is not taken into consideration. Civil wars are dynamic and battlefields will change with time. Tactics as well as places of interests for both sides change, so does the location of battlefields as a result. Locations of combats would also be affected by the changing power ratio between the government forces and rebels. If rebel groups acquire successfully military assistance and support from contiguous states or distant great powers, while the government is losing its advantage, then we should see that the main battlefields move toward the capital or other important targets instead of being fixed and remain at the same place.

Raleigh et al's dataset (2006) also suffers from the common "time-invariance problem" for datasets including geographical data, though a notice is given in the codebook of dataset. In measuring the size of battlefield and its distance with the capital, time-invariance exists not because of the intrinsic nature of the data but of the wrong conceptualization and measurement. On the other hand, the *Conflict Site Dataset* (Raleigh et al, 2006) fails to deal with the issue that there might be multiple battlefields in different stages of a civil strife, which is quite common.

Another possible way to conceptualize main battlefields is to include all cases during a specific period of time. The place where a conflict has taken place will be recorded as a conflict zone. This is how Buhaug and Rod (2006) and Gleditsch et al (2002) conceptualize battle zones in civil wars. This method will generate a minimal geographical plane that includes all events that have ever happened during the internal war. However, this concept may cause a research issue because war events are not evenly distributed within the zone of conflict. Figure 1.2 visualizes this issue[9]. In the center there is clearly a cluster of war events, as several other events are scattered in the border area. The effect of war is apparently different for the center and periphery areas. If there is only one isolated attack and we designate all the places with one battle/attack to be the battlefield, we may run the risk of including too many "non-cases," when some places may only suffer from a single attack within 3 years while others dozens of attacks in months even weeks. In other words, the difference in intensities within the battle zone is not well addressed and dealt with.

I argue that to know where the main battlefields are in civil wars, we should look for

[9] In this polygonic battlefield, there is a cluster in the center, demonstrating the concentration. While combats are most intense in the center, the border zone is also defined as battlefield though there are only sporadic fights. This definition of battlefield apparently creates an inconsistency in conceptualization.

clusters of battles. A battle cluster indicates intensity of combats, the willingness and capability of each side of war, and the importance of targets. The two essential elements in the gravity model-distance and mass-are used to support my conceptualization. The gravity model (Zipf, 1946) assumes that greater mass generates greater gravity, and more distance generates less gravity between two objects. Similarly, I assume that the more intense the battle is, the more influence it would have for local environment, ecological system, economic and spread of disease. The closer the battlefield to the concerned object, the more influential it would be. Proximity is also a key link in spatial epidemiology. The closer people are to pathogens the more probably they are to be infected. Proximity increases the probability of exposure, so does time. The temporal aspect is another essential concept of intensity. Battlefields are not only clusters of concentration of combats in space but also in time. Concentrated attacks that take place in a short period of time around a possible target also indicate the importance of the target, a high level of hostility between the government and the rebels, and of course a larger impact to the surroundings. Only with the temporal information of war can researchers identify casual relationships between different variables of interest.

1.5 DATA AND GEOGRAPHICAL PATTERN OF CIVIL WAR

The prerequisite to successful cluster detection depends on sufficient and reliable location data. The Armed Conflict Location and Events Dataset (ACLED) by Raleigh and Hegre (2005) is a good source for geographical analysis or visualization. Using various news sources as information, ACLED records different events in civil wars by assigning each event coordinates (longitude and latitude in decimal degrees). The basic unit of analysis (or study unit) in the ACLED dataset is a daily event between at least two warring parties, or a dyadic event-day, recorded as either the interaction between the government and rebel forces, between different armed groups or unilateral actions taken by each side. ACLED has been updated for several times since 2005. In the original dataset, there were 13 countries (Angola, Burundi, Central African Republic, Congo, Democratic Republic of Congo, Cote D'Ivoire, Gabon, Guinea, Liberia, Rwanda, Sierra Leone, Sudan and Uganda) in 12 conflicts. ACLED is coded mainly based on the Uppsala/PRIO armed conflict dataset with some differences. The earliest ACLED dataset (the best version) has 4,746 observations[10], and events are categorized into six types:

(1) "A battle resulting in no change of territory;"

(2) "A battle resulting in a transfer of territory to the rebel actor;"

(3) "A battle resulting in government forces recapturing the rebel held territory;"

(4) "A rebel base or headquarter established;"

(5) "A no-battle-related rebel activity," and

(6) "A territorial transfer to the rebels at an unknown date (Raleigh and Hegre, 2005, 7)."

The ACLED dataset contains abundant disaggregated information for each conflict it records. First, one civil war is broken down into events with different categories with geographic locations, dates and warring parties. Second, they are point event data, giving researchers greater flexibility to use them. Unlike most statistical data recorded by country or administrative regions, users can aggregate the data points into different study

[10] For details please visit the ACLED website: http://www.acleddata.com. In November 2009, most African countries' location event data are available. The project seems to have new categories on event types. According to one of its reports, Types 1, 2 and 3 remain similar. Type 4 is expanded and records "non-violent rebel activity, including recruitment, meetings and presence" besides base establishment. A new category Type 7 is created and records "violence against civilians by either rebel or government forces." In the latest version, riot are recorded in some countries too. See http://www.acleddata.com/documents/Central%20African%20Republic_Feb2009.pdf.

regions or just use them as point data depending on what their research aims are.

In my analysis, I use the Sierra Leone Civil War (1991-2000. Conflict No. 187 in the UCDP/PRIO dataset) as the example to show how the most intense battle clusters can be formed. Only battle events (i.e. Events Types 1, 2 and 3) would be used as the units of analysis in the civil war. With the assistance of GIS software, battles can be plotted on the map (See Fig. 1.3) while relevant geo-statistical analysis can be done.

Figure 1.3 shows the distribution pattern in the Sierra Leone Civil War. It generally demonstrates a sporadic spatial distribution, while there seems to be some clusters around Freetown, the capital of Sierra Leone. One important reason behind this is the essence of warfare taken by both sides in civil wars. According to Holsti (1996), only about 15% to 20% of armed conflicts around the world are conventional wars (22-24). Fearon and Laitin (2002) also report that most civil wars that take place during the post-Cold War era are fought in the form of insurgency and urban guerrilla warfare. Kalyvas (2006) argues that guerrilla warfare is the dominant form of civil wars; civil wars fought in conventional warfare are very rare in history, while some internal conflicts are mixture of guerrilla and conventional warfare (90). Unlike their counterparts in conventional wars, combatants in civil wars do not seek decisive battles that Clausewitz (1832 [1943]) suggests; on the contrary, they attempt to "win by not losing," turning the conflict into an "attrition warfare." Smith (2003) describes the process of the guerrilla warfare as:

> "….the state (or incumbents) fields regular troops and is able to control urban and accessible terrain, while seeking to militarily engage its opponents in peripheral and rugged terrain; challengers (rebels or insurgents) 'hover just below the military horizon,' hiding and relying on harassment and surprise, 'stealth and raid (23).'"

For guerrilla warfare, there are no clear frontlines between two armies (Kalyvas, 2006). With skirmish and harassment tactics, engagements between the government armies and the rebels usually disseminate across the land sporadically within the country. Compared with conventional wars, guerrilla wars have lower rates of battle deaths (i.e. "low intensity conflicts (LICs)"). Battles in civil wars are often distributed geographically as "islands" without clear borders of battle zones (Buhaug and Lujala, 2005, 405-406). The central government usually engages with multiple "peripheral groups" including rebel organizations, ethnic groups, terrorists and/or insurgent actors (Cederman et al, 2006). All these make attempts to detect and to locate the spatial intensity of civil wars more difficult.

1.6 CLUSTERING BATTLES SPATIALLY AND TEMPORALLY IN CIVIL WARS

We are, however, still able to demonstrate local differences of battle frequencies in civil wars. A way that geographers usually use is to aggregate or disaggregate data by areas. In the example of Sierra Leone, we can accumulate events by District, the second administrative region of the country. Then we can use either the total numbers of events in a specific region or the density of battles in the region to rank districts so as to decide which district has the most battles (counts) or the highest battle density. However, this method would cause some problems. First, events do not evenly distribute in each District. Geographers usually get the local statistics at second or third administrative regions, such as counties, *rayonis* (in former Soviet Union republics) or other similar regions, and each local unit varies in size or other characteristics. For example, in Bombali District, most battles erupted in the southeastern part near the border with Tonkolili District. If we use battle density (numbers of battles divided by area) as for ranking, the result may be “deflated” and the researcher may underestimate the actual havoc because in the southeastern part sits Makeni, the largest city of Bombali and the Northern Province. Second, aggregate data points at different level would produce different results. This is the well-known Modifiable Areal Unit Problem (MAUP) (Openshaw, 1983). Figure 1.4a and Figure 1.4b demonstrate the problem. When the battle density is measured at the provincial level, the Western and Eastern Provinces still show higher density of battles, but some local battlefields in the Northern and Southern Provinces disappear with the change of statistical units and scale.

To avoid the problem caused by different sizes and scales of local areal units and to get more consistent results, some researchers use the quadrat sampling method (or “quadrat analysis”) to deal with spatial variation. The method is to divide the area of study into many grids/cells of same size and calculate the number or the density of events in each cell to see whether there are clusters (de Smith, Goodchild and Longley, 2008). An example is Buhaug and Rød (2006). They disaggregate the whole African Continent into thousands of 100x100km grid cells. With other disaggregated data, researchers are able to run econometric models using grids as units of analysis to test whether some independent variables widely used at the country level can still explain the onset of civil war at the local level.

One method similar to the quadrat analysis is the kernel density estimation (KDE). The kernel density method is widely used in statistics to “smooth” data points by moving a three-dimensional using each data point as the center. The kernel estimator is defined as (Silverman, 1986):

$$\hat{\lambda}(x) = \frac{1}{nw}\sum_{i=1}^{n} K(\frac{l-l_i}{w})$$

where w is the window width, or bandwidth, and K is the kernel function. There can be several kernel functions to choose, with Gaussian function the most used one. The bandwidth would determine the "smoothness" of the estimates. If there are multiple data points on the same location (overlap kernels), density would be increased as well. Figure 1.5 shows where battles are most intense in the Sierra Leone Civil War[11]:

White dots indicate possible clusters of battles, while the brightness of dots shows density of battles. The brighter the dots are, the more there are concentrated combats, or higher battle intensity. Although quadrat sampling methods and KDE are useful tools for detecting clusters, researchers still have methodological constraints. Quadrat analysis still suffers from the MAUP, as the choice of grid sizes could affect the final results. There is a tradeoff of cell size, efforts of data collection and data quality (i.e. the larger the cell, the easier it is to collect data but with a decreased quality). The choice of cell size depends on researcher's discretion. For KDE, it is still difficult for researcher to specify main battlefields/clusters in a civil war because too many cluster results are produced, while at the same time those clusters lack clear borders[12], making calculation and use more difficult. The most prominent issue here is the negligence of temporal aspects. Time is much less emphasized in geographic studies than in political science. In the example of Sierra Leone Civil War, since capital is always an easy target for rebels, multiple battle clusters are expected to take place in or around Freetown. However, a cluster may include battles fought between government and different rebel groups in different months/years

[11] I use the kernel density function in the Arc Toolbox of ArcGIS 9.2 to look for possible clusters of battles. The default setting of bandwidth in ArcMap is used.

[12] Or "fuzziness" or the "surrounding zones of uncertainty." See Jacquez, G.M., "Spatial Cluster Analysis." In Wilson and Fotheringham eds. *The Handbook of Geographic Information Science*. Malden, Mass: Blackwell Publishing.

from the beginning of war to the end. When a civil war is studied as a single event without any time variance, researchers actually "lump" different events together. For spatial epidemiology and criminology, this would not be an issue because the time spans are relatively shorter (several months to years) and more homogenous (the object of study is usually a specific disease). In civil wars, however, waves of attacks may be initiated by one or several specific groups of rebels, which may demonstrate a concentrated pattern in some specific phases and/or places during the war.

To deal with possible research issues such as ones mentioned above, I would like to use space-time scan statistics by Kulldorff et al (Kulldorff, 2001; Kulldorff et al, 1998; 2005). Scan statistics are widely used in natural sciences to detect possible cluster of events in an area of study. Epidemiologists use scan statistics to detect unusual clusters in a specific study area to find out possible factors that cause the anomaly of distribution or concentration. The scan statistics can be either spatial (cluster on a two dimensional plane) or temporal (cluster along the timeline), or it can be a space-time process (a three-dimensional cluster formed in a space-time dimension).

Kulldorff et al (2005) develop the software *SatScan* to handle data for analysis. The software generates myriads of "windows" using each point event as the center over the surface to find out possible clusters. For spatial scan statistics, the window is 2-dimensional and can be circular, elliptic or rectangular. For the space-time scan statistics, the window is a 3-dimensional cylinder (the height is time). Each set of data points "bracketed" by any cylindrical window would be compared with the number of data points outside the window to see whether the set of data points within the window makes a "cluster." Mathematically, it can be written as:

$$\left(\frac{c_W}{\mu_W}\right)^{c_W}\left(\frac{C-c_W}{C-\mu_W}\right)^{(C-c_W)} \qquad (1)$$

where C is the total number of data points in the area of study, defined as

$$C=\sum_i \sum_t c_{it} \qquad (2)$$

C is the sum of all data points (or cases) in different area *i* and time *t*; and c_w is the number of cases that fall into the window *W*; μ_w is the expected number of cases in window *W*, defined as

$$\mu_W=\frac{\sum_i c_{it} \sum_t c_{it}}{\sum_i \sum_t c_{it}},(i,t)\in W \qquad (3)$$

Maximum likelihood would be calculated using (1), and the window that has the highest value is considered the most possible space-time cluster (Kulldorff et al, 2005, 218). Monte Carlo process is used to test the statistical significance of clusters. I use *SatScan* to run a space-time permutation model with default settings[13]. Clusters are generated using the Monte Carlo (MC) process that generates 999 (or 99 or 9,999) draws. The observed

[13] For SatScan, configurations of spatial and temporal window sizes are there. The default setting is that the maximum size of both spatial and temporal windows does not cover more than 50% of total cases. Users also have to set up the time accumulation and time precision for their data. I use "year" as the basic unit of time precision and accumulation to be compatible with the yearly format used in most datasets that record intrastate conflicts, though the temporal precision of ACLED is "day."

distributions will be compared and ranked with the random sample. For example, if the observed distribution ranks number one among 999 random draws, then the p=0.001. Clusters with P-values above p=0.05 are dropped.

In the case of Sierra Leone, five main battlefields/clusters are produced by *SatScan* (Table 1.1). Important geographic information can also be obtained. They include:

- <u>The radius of each battle cluster:</u> this is an important measure of the size of main battlefields in civil wars. The large the radius of the cluster is, the more territories of the country are under the influence of war.
- <u>Coordinates of cluster centers</u>: the center of estimated battlefields. Coordinates can be used to calculate the distance between the battlefield and other important places.
- <u>Dates of beginning and end of each cluster:</u> the duration of cluster. Longer time can indicate more intensity.
- <u>Numbers of locations:</u> the number of places involved in the main battlefield.
- <u>Numbers of battles included in each cluster circular border</u>: can be used to evaluate local intensity of the conflict.

Three new variables are also generated: duration, capital-battlefield center distance (CBD) and capital tangent distance. Duration is in years. Capital-battlefield center distance is the distance of capital and battlefield center, while tangent distance is defined as the difference between CBD and cluster radius. The purpose is to see whether the capital is included in any of the clusters.

Visualization would help us see more clearly how the Sierra Leone Civil War is fought across the region and time. Figure 1.6 shows that the first battlefield is mainly in the southern coastal Bonthe District, while some of the Moyamba District is covered.

Beginning in 1992 another battlefield emerged in the eastern Kailahun District sitting on the borders with Liberia and Guinea. From 1994, the battlefield moved to the center of the country. There is no statistical significant cluster in 1997. From 1998 to 2000, we can see the war swept across the Northern Province from east to west and finally reached the capital Freetown. It is clear that in 1998 the main battlefield of the Sierra Leone Civil War includes most of Koinadugu, eastern Kono, west Tonkolili, southeastern Bombali and the northern tip of Kenema. The direction within the Sierra Leone Civil war would not be shown if we aggregate our data by Districts. Figure 1.7 is the original battlefield size depicted using Raleigh et al. (2006) *Conflict Site 1946-2005 Dataset*. The center of conflict site is set to be 150 km with a centroid at 8 Degree North and 12 Degree West. This circle covers more than 3/4 area of Sierra Leone but does not change with time. The result produced by *SaTScan* shows the difference between the old and new concepts of battlefields in civil wars.

Qualitative and case studies support and explain the "path" of war described above. The Sierra Leone Civil War began in southeastern part of the country after troops of Charles Taylor, the president of neighboring Liberia, entered Sierra Leone in March 1991. This is captured by Cluster No.2 located near the Sierra Leone-Liberian border. The main rebel group, the Revolutionary United Front (RUF) attempted to occupy Bo and Kenema Districts but failed due to poor training and propaganda (Richards, 2001, 42-43). Clusters No.1 shows earlier, failed RUF attempts and conflicts with the government force in the Bonthe District. In November 1996, the newly elected president Ahmed Kabbah signed the peace accord with RUF, and the truce was remained for less than a year. This may explain that in 1997 there were no significant combat cluster between the government and RUF. In 1998, the Economic Community of West African States Monitoring Group (ECOMOG) forces were deployed in Sierra Leone and had intense fights with the RUF (Cluster No.4). In 1999, RUF launched final attack that was dubbed “Siege of Freetown.” The rebels also engaged with the British paratroopers and UN peacekeeping forces in Freetown around April/May 2000 (“Timeline: Sierra Leone”). This is well captured by Cluster No.5, which is also the largest and most intense cluster (has 74 concentrated battles in 34 locations with a 78.63 km radius) among all.

1.7 CONCLUSION AND FUTURE RESEARCH DIRECTIONS

Using spatial-temporal clustering techniques, I demonstrate the possibility to conceptualize the intensity of civil wars in different ways using the case of Sierra Leone Civil War from 1991 to 2000. Battle intensities in different phases can be identified, located and visualized, as the local sizes of war can also be measured. Besides, we can now realize how and where the war travels through the country. The “path” of war is now able to be tracked, just like we can track hurricanes and tropical storms.

This new concept of intensity and time-space scan statistics can benefit both macro-level large-N and micro-level studies on contemporary civil wars. For quantitative studies, data generated by *SaTScan* can help researchers calculate distance between main battlefields and other important variables of interest. With temporal characteristics of each main battle cluster generated, causal relationship between the battlefield and other variables can thus be established. Clustering methods can help researchers to do further exploratory spatial data analysis. Once we can locate the most intense clusters of battles, we can examine the relationship between main battle clusters and proximate variables deemed important at the state level, such as petroleum (the Petrodata, Lujala and Rod, 2007), diamond ores (Diadata, Gilmore et al, 2005), and other important socio-economic variables such as population density, poverty rates and local economic performances or trade. Many researchers are currently collecting locational data on events other than battles. For example, Dorussen (2007) compiles a new dataset PKOLED (Peace Keeping Operations Location and Event Dataset), which locates each UN peacekeeping operation events since 1989. Weidmann et al (2010) also complete the GREG (Geo-Referencing of Ethnic Groups) dataset, which locate the distribution of ethnic groups at the sub-national level in polygons. With more such datasets, many other variables can be generated using GIS. Clustering techniques would also help detect possible clusters near the borders, which is deemed an essential factor in the spread of interstate war (Starr and Thomas, 2005). This may shed light on the role that borders play in civil war, and probably on the transnational diffusion of civil wars.

For qualitative research, battle cluster detection would help researchers to discover new variables to explain the war-proneness in some specific area. In addition to academic importance, the detection of battle clusters can also have policy implications. By locating the most spatially intense battles, we can identify and locate areas most damaged by war so as to evaluate the damage and determine the priority for rescue and rebuild for the postwar reconstruction.

Another important implication of rethinking the concept of battlefields in civil wars is that it introduces a dynamic way of conceptualizing civil war. Traditionally political geographers tend to explain the location of civil wars with variables such as population density, distance to the capital, etc. The concept of time-space clusters would prompt researchers to ask questions like: “why in some specific period of time in some specific place battles are more likely to happen than other space and time?” As researchers can find out battle clusters within a civil war, some dynamic seasonal variables such as flood and drought, or sudden natural disasters such as hurricane and earthquake may then be used to explain either the onset or direction of conflicts.

Table 1.1: Main Battlefields in the Sierra Leone Civil War (1991-2000)

Cluster	Latitude	Longitude	Radius (km)	Start Date	End Date
1	7.526	-12.5050	32.85	1/1/1991	12/31/1993
2	8.133	-10.7333	18.12	1/1/1992	12/31/1993
3	8.091	-12.1280	42.16	1/1/1994	12/31/1996
4	9.066	-11.4833	67.39	1/1/1998	12/31/1998
5	8.983	-12.7833	78.63	1/1/1999	12/31/2000

Cluster	# of Locations	P-Value	Observed	Expected	Center-Capital Dis.	Tangent Distance
1	7	0.001	32	7.9	133.4	100.55
2	3	0.001	15	2.2	277.9	259.77
3	6	0.001	18	5.2	129.4	87.23
4	26	0.001	51	22.1	204.1	136.70
5	34	0.001	74	30.2	74.4	-4.23

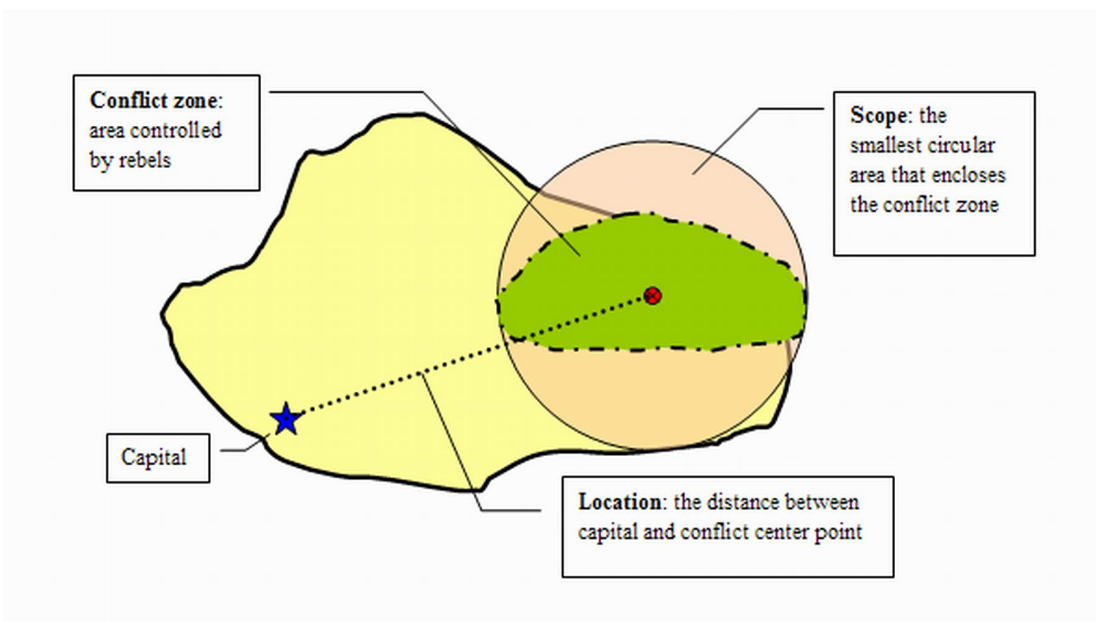


Figure 1.1: The Scope of Conflict Concept of Buhaug and Gates (2002)

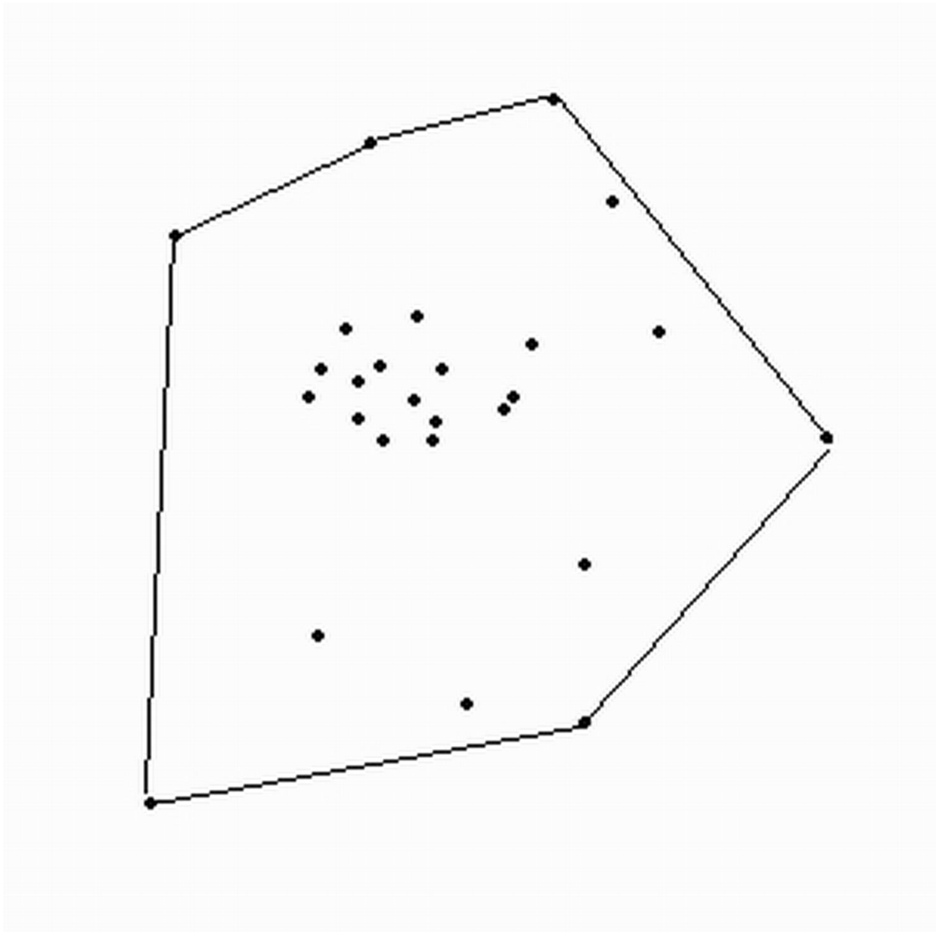


Figure 1.2: The Uneven Battlefield

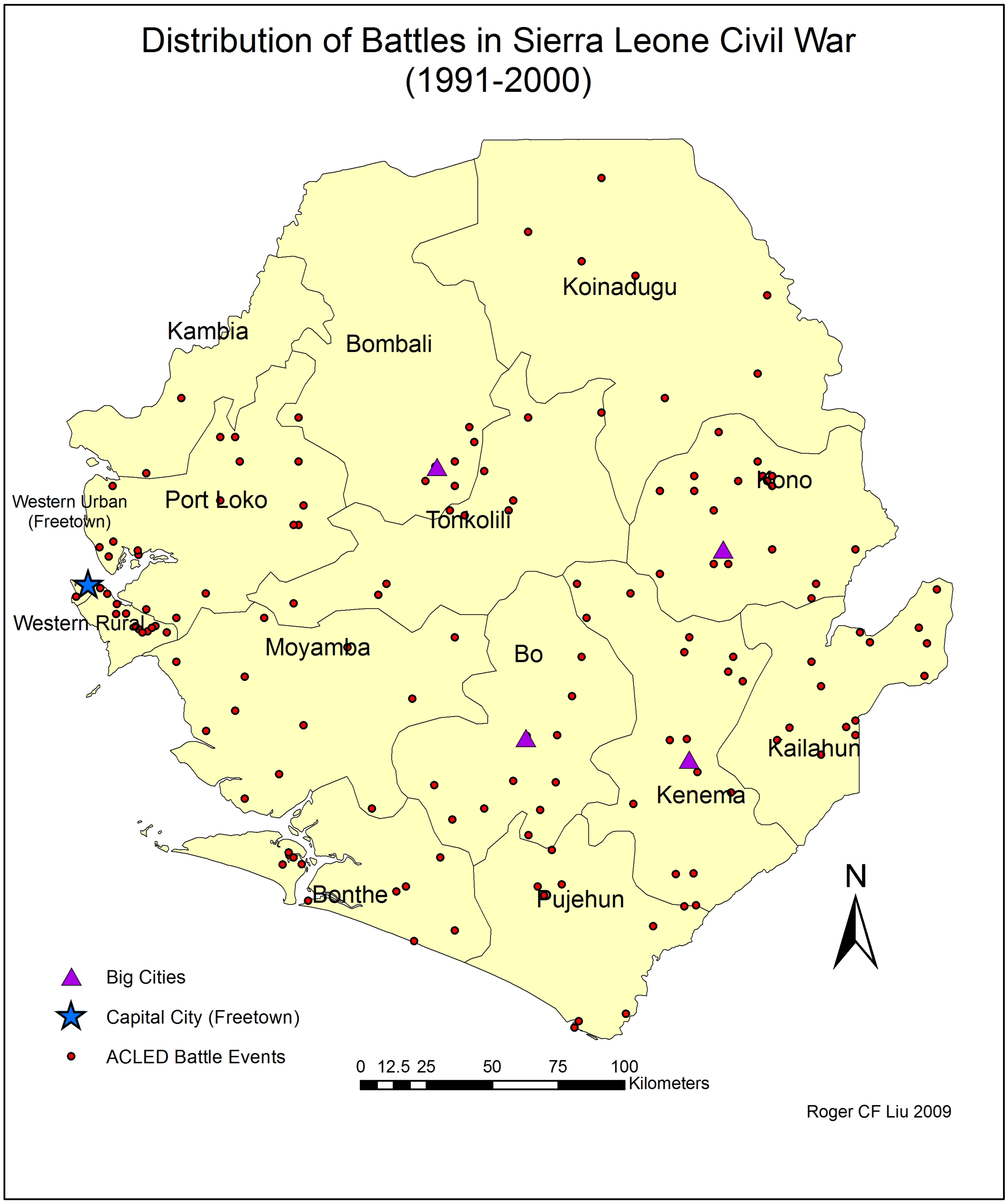


Figure 1.3: Battle Points of Sierra Leone Civil War, 1991-2000

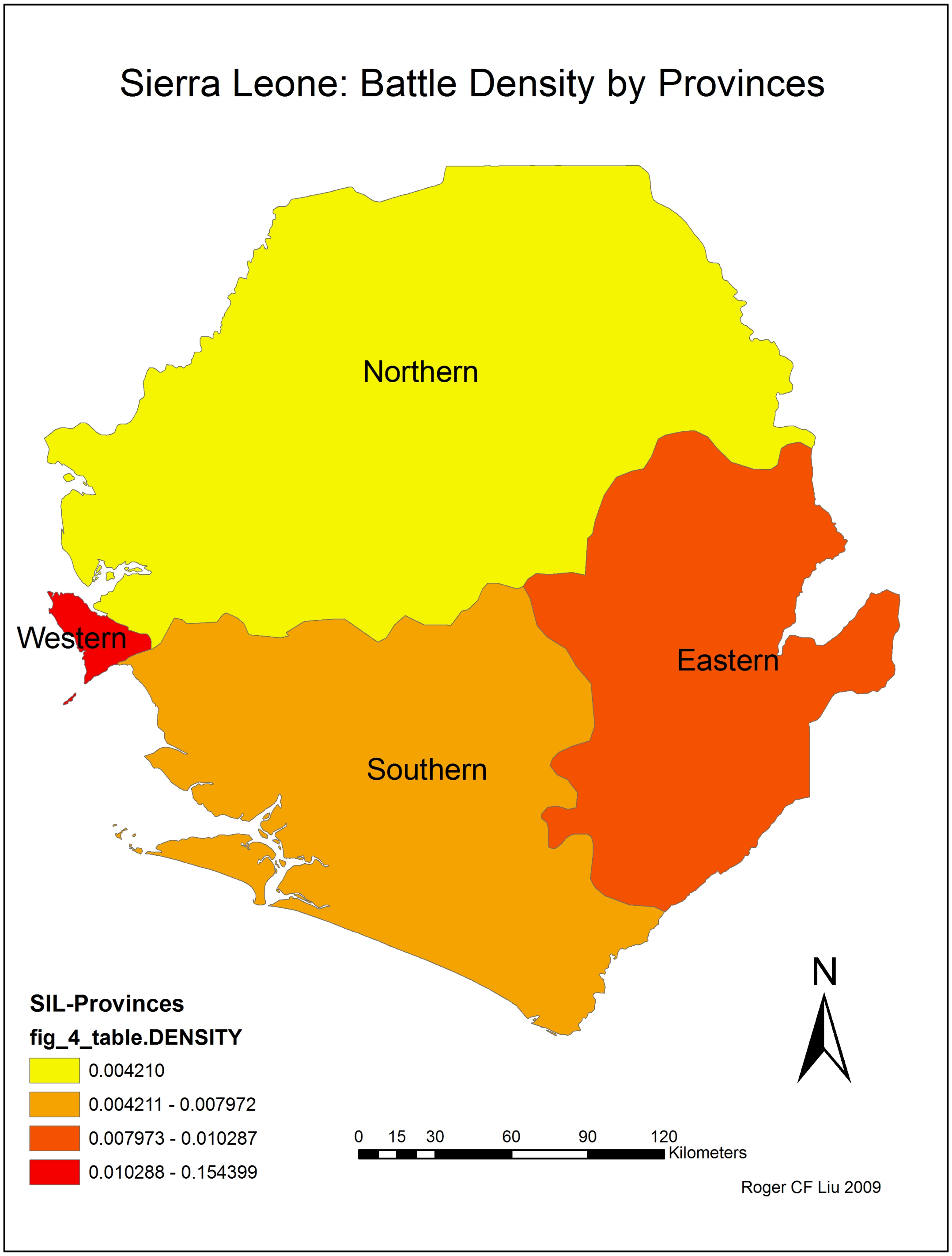


Figure 1.4a: Battle Density Map by Provinces

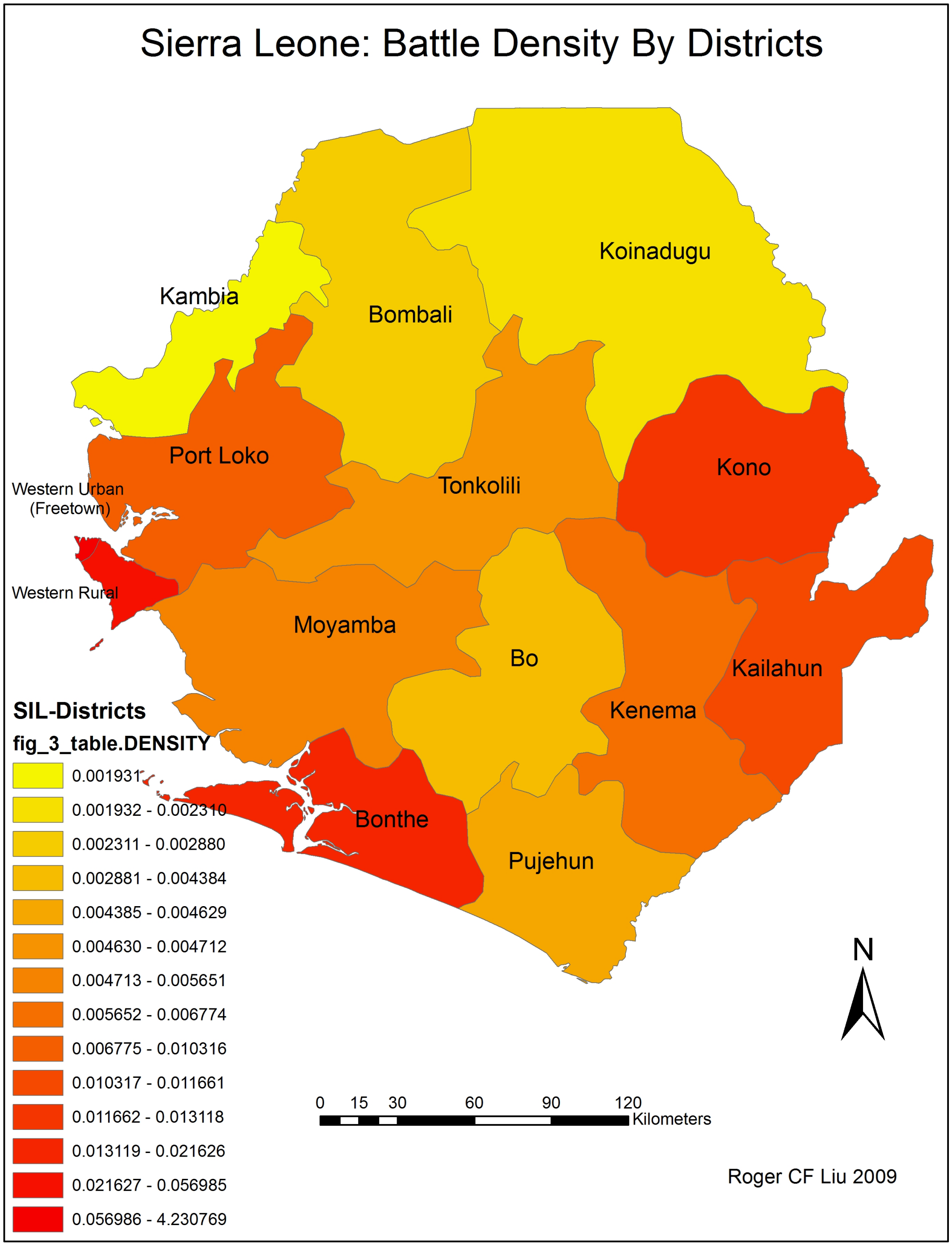


Figure 1.4b: Battle Density Map by Districts

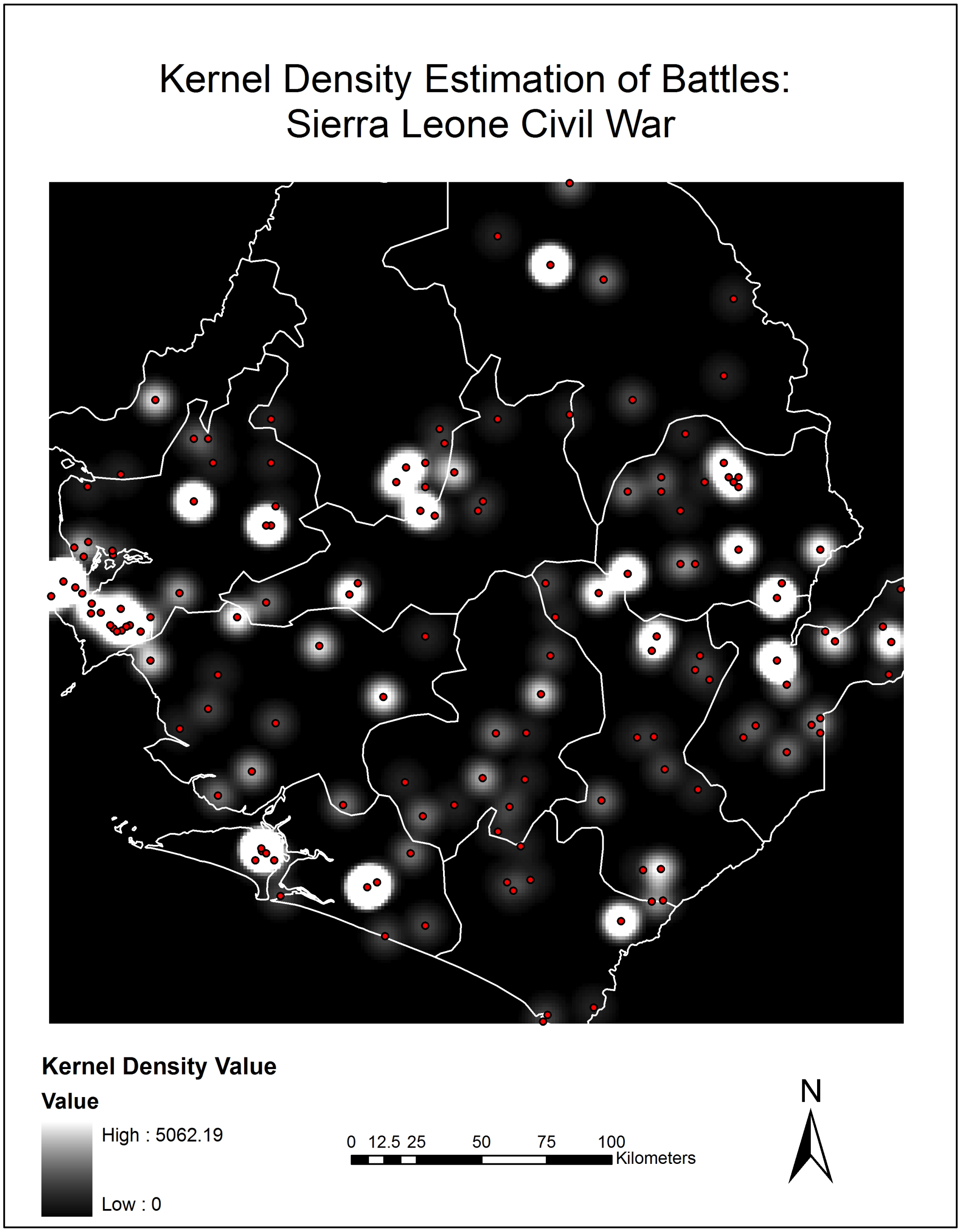


Figure 1.5: Kernel Density Estimation of Battles

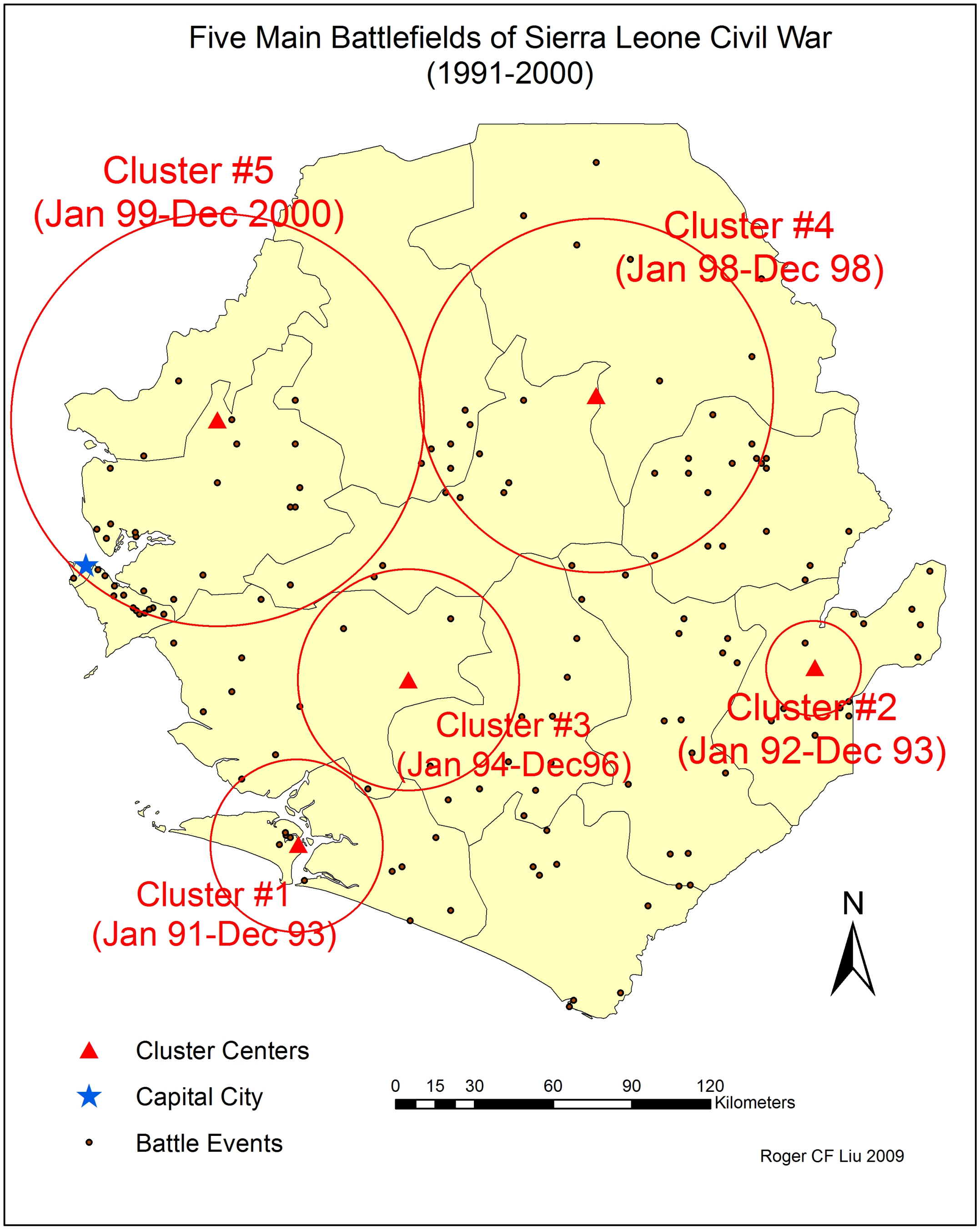


Figure 1.6: Map of 5 Main Clusters

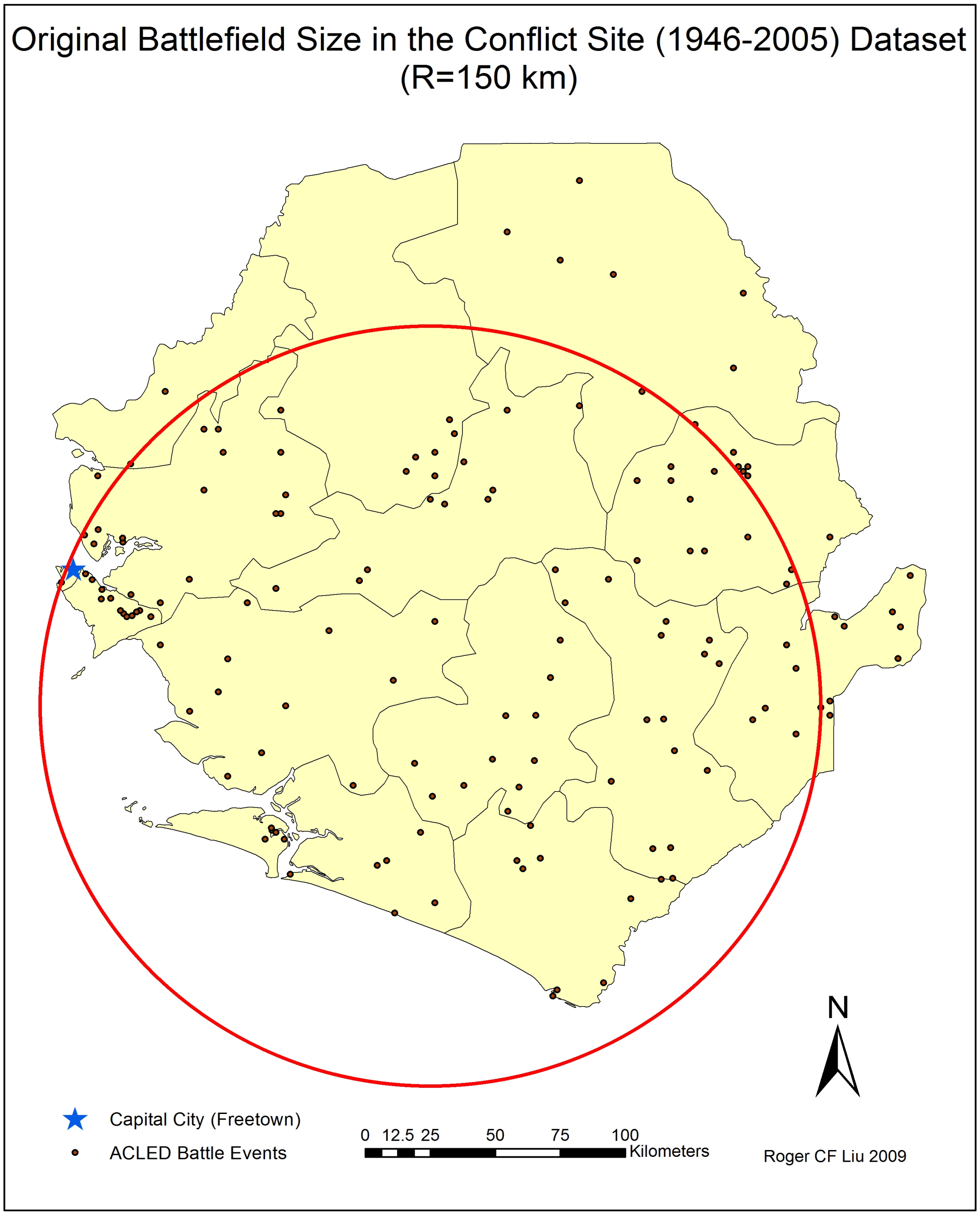


Figure 1.7: The Map of Battlefield in Raleigh et al (2006)

CHAPTER 2:

"EXPLAINING WHERE (AND WHEN) THE MAIN BATTLEFIELDS ARE IN CONTEMPORARY INTERNAL ARMED CONFLICTS"

2.1 CLUSTERS OF CONFLICT: WHAT THEY ARE AND WHAT THEY MEAN

Using the size of battlefields as an indicator of intensity is not a totally new idea, but it has been paid less attention because it is difficult to measure them. To study where most intense battles occur would enable us to answer some important questions in the study of civil wars and insurgencies. Traditionally, the number of battle deaths (mostly comprised of combatant deaths) is widely used to construct magnitude, severity and intensity[14] of interstate and intrastate armed conflicts (Richardson, 1960; Singer and Small, 1972; Small and Singer, 1982). However, researchers have more recently begun to criticize the use of battle deaths as the dominant measure of war intensity in both interstate/internal conflicts. The first criticism is toward the narrow focus of traditional concept of intensity. Moore (2005) criticizes how battle deaths are used in the COW project as a "particularistic conceptualization" and argues that there are "many dimensions of intensity of war (8)," which may produce productive answers for the study of war but are neglected in the COW measurement. Using the example of Vietnam War, Mueller (2004) finds that the probability for an American youth to be killed on a Vietnam battlefield was approximately as the same as driving on the road (268-269). Interpersonal violence, according to O'Loughlin and Raleigh (2007), kills more than interstate and/or intrastate

[14] As for the operational definitions of these three indicators, please see Singer and Small (1972) and Small and Singer (1982).

wars worldwide (493). That non-combatant civilians account for more casualties is also reported by a number of other researchers (Melander, Öberg and Hall, 2006; Lacina and Gleditsch, 2005; Rummel, 1997; Harff, 2003; Ghobarah, Huth and Russett, 2003). On the other hand, validity and reliability are also issues in the measuring of battle deaths (Lacina and Gleditsch, 2005). At the methodological level, the intensity measure also has some deficiencies. Battle death also serves as the cut-off criterion in COW (1,000 battle deaths per annum). Sambanis (2004) argues that the rigid cut-off line of 1,000 annual battle deaths would make operationalization problematic, preventing researchers from studying escalation in civil wars (818). Another major research issue for using the current measure of battle deaths in relevant conflict databases is that for most of the time users cannot know how the severity or intensity of war evolves over time and how they differ in different places in any particular country (or theater of war) because differences are averaged out.

The idea to measure interstate or intrastate wars in regard to a spatial scale is not totally unfamiliar to political scientists. Singer and Small (1972) discussed measuring the magnitude of conflicts in a "spatial" dimension. Calculating the size of battlefields and the number of battles are both considered possible measurements of war magnitude (43). Moore (2005) also mentions using the "size of territory under dispute" to measure different conflicts. However, due to the limit of measuring techniques and lack of geo-referenced data, that effort has not been realized in political science. The recent trend to disaggregate civil wars among political geographers and intrastate war researchers has brought many new methods from another discipline and improved the accessibility of geo-referenced data. Researchers such as Buhaug and Lujala (2005) discuss how local characteristics and factors causing civil wars such as terrain, natural resources, population or ethnicity can vary in different areas of a country. To study civil wars only at the national level, they argue, would eliminate the variation and have incorrect or insignificant results (404); and thus, validity issues. Also, the study of borders, economic performance and neighboring civil wars needs to pay attention to sub-national location, because the country-level aggregated data may conceal important information of distance and location and yield inaccurate results (403). The location of war can also reveal important information such as the relative capability of different warring parties (Lowi, 2005; Buhaug, 2006; Kennedy, 1998) as well as different kinds of grievances (Kimenyi and Ndung'u, 2005; Gleditsch et al, 2002).

The location of conflicts address other important topics that attract more attention in the current study of intrastate wars, such as civilian casualties, refugees, genocides, the spread of disease, and post-war recovery, etc. Armed conflicts and these issues are spatially correlated. The number of civilians killed or wounded is expected to be higher in areas of conflict than other places in the country at war. War brings disasters to the local population, and people who live in or near the battlefield would bear the largest impact of war. A relevant issue is refugees and interally displaced persons (IDPs). Melander and Öberg (2007) report that forced migration in civil wars is determined by the geographical size of war rather than the battle-deaths-based measure of intensity. Recent examples from North Kivu Province in Democratic Republic of Congo (DRC)--the main battlefield of the Second Congo War (1998-2003) and the Kivu Conflict--shows the tyranny of proximity (BBC, 2009). The location of internal wars also has great influences on the contagion of diseases. Wars help spread infectious diseases such as cholera, dysentery, plague, smallpox, typhoid and louse-borne typhus fever (Smallman-Raynor and Cliff, 2004). The mobilization and concentration of troops in the battlefield increase the probability of infection and spread of diseases. Poor hygiene and nutrition brought by wars such as the destruction of health infrastructure, poor management of bodies and internment and famine all help the development of epidemics; large-scale population movements spread diseases. Cases found by Smallman-Reynor and Cliff (1999; 2004) and Proctor et al (2005) in African internal armed conflicts and in the 1991 Gulf War all indicate the relevance of battlefield location and the severity of epidemics or diseases. The havoc that wars bring to a local environment and ecological system can cause disastrous problems. Weapons such as Agent Orange and the pesticides used in the Vietnam War caused serious deforestation in local areas. In the first Gulf War (1990-1991), the Iraqi Army blew up 730 oil wells and some of them gushed out large amount of crude oil, causing ecological disasters for local fauna and environment (Stead, 1997). Battlefields and the neighboring areas would suffer more economically than other unaffected areas. Means of production such as plants, factories, tools and machines tend to fall prey to rebels, which would delay the post-conflict recovery. Battles destroy schools and bring educational difficulties for the region. The battlefield trauma also causes some physical and psychological problems for people in the area. Weapons left in the battlefields such as mines, unexploded mortars and sub-munitions from cluster bombs continue kill and maim people in the area after the conflict ends (Pasha, 2008).

Two important elements of main battlefields are location and concentration. It is not easy to know the locations of conflicts especially for civil wars and insurgencies because many of them are fought as guerrilla wars. Guerrilla warfare is found to be the dominant form of civil wars (Holsti, 1991; Fearon and Laitin, 2003); civil wars fought in conventional warfare are very rare in history, while some internal conflicts are mixture of guerrilla and conventional warfare (Kalyvas, 2006). Unlike their counterparts in conventional wars, combatants in civil wars do not seek decisive battles; on the contrary, they attempt to "win by not losing," turning the conflict into "attrition warfare (Smith, 2003)."[15] There are no clear frontlines between two armies in guerrilla wars (Kalyvas, 2006) and at the same time the strategy to spread the war across the country is also encouraged to attain success (Clausewitz, 1832[1943], 458; O'Sullivan and Miller, 1983, 114). With skirmish and harassment tactics, engagements between the government armies and the rebels usually disseminate across the land sporadically within the country. Compared with conventional wars, guerrilla wars have lower rates of battle deaths. Battles in civil wars are often distributed geographically as "islands" without clear borders of battle zones (Buhaug and Lujala, 2005). The central government usually engages with multiple "peripheral groups" including rebel organizations, ethnic groups, terrorists and/or insurgent actors (Cederman et al, 2006). All these make attempts to detect and to locate the spatial intensity of civil wars more difficult. Current efforts to define the size of conflicts and to measure the location of war suffer from inaccuracy and time-invariance. Time is an important element in measuring the intensity and main battlefields in contemporary civil wars. But in Buhaug and Gates (2002), Gleditsch et al (2002) and Raleigh et al (2006), the concept of war location does not change with time,

[15] Not all civil wars are fought in guerrilla warfare, e.g. the American and Spanish Civil Wars. According to Huntington (1962), guerrilla warfare is the main form of warfare especially in earlier phases of internal wars, but it does not apply to every civil war. An example that conventional warfare dominates the whole course of war is the Chinese Civil War (1945-1949) between the Nationalists and Communists. Both sides had well-structured military institutions with clear orders of battle, and the war was characterized and determined by three major campaigns-Liaoshen, Huahai and Pingjing taking place in Eastern China. See Fairbank J and A. Feuerwerker eds. 1986. *The Cambridge History of China: Republican China (Vol. 8): Part 2*. Cambridge UK: Cambridge University Press.

and the concentration patterns of conflicts in different locations are not discussed either.

I argue that to know where the main battlefields are in civil wars, we should look for clusters of battles. I assume that the more intense the battle is, the more influence it would have for local environment, ecological system, economy and spread of disease. The closer the battlefield to the concerned object, the more influential it could be. Proximity is also a key link. The closer people are to pathogens the greater the probably that they will be infected. Proximity increases the probability of exposure, so does time. The temporal aspect is another essential concept of intensity. Battlefields are not only clusters of concentration of combats in space but also in time. Concentrated attacks that take place in a short period of time around a possible target also indicate the importance of the target, a high level of hostility between the government and the rebels, and of course a larger impact to the surroundings. Only with the temporal information of war can researchers identify casual relationships between different variables of interest.

2.2 EXPLAINING BATTLE CLUSTERS WITH NON-STATE ARMED GROUPS (NSAG)

How can we find and explain the location of major battlefields? I use armed groups[16] to explain the local intensity and distribution of combat events in contemporary internal armed conflicts. The non-state armed group, or NSAG, is an important actor in modern internal armed conflicts in places from Sub-Saharan Africa to Afghanistan. Most wars, instead of being fought between states, are between states and armed groups or between different armed groups (Spear 2004, 18). NSAGs are major actors engaging in violent conflicts; no matter they are ethnic, revolutionary, separatist or criminal ones. As indicated by Sinno (2011), "[e]thnic groups, social classes, peoples, civilizations,

[16] Or "non-state armed groups (NSAGs)" or in a broader sense, VNSAs (violent non-state actors).

religions, and nations do not engage in conflict or strategic interaction – organizations do (311)."

However, NSAGs are not given much attention that they deserve in current studies of the geography and location of war. The underlying assumptions in studies on modern civil wars are that the conflicts occur between the state and a rebel group, and the formal models used are based on these assumptions (Gledistch et al 2009; Buhaug 2010). However, the traditional concept of a dichotomy of a state government occupying the capital and a rebel group does not quite describe what happens in modern day internal armed conflicts. Munro (2004) describes how North Kivu has been "penetrated" by multiple actors – foreign and local governments, rebels and different branches in the state. Over the same area multiple parties desire to exercise their influence and control.

I argue that the existence of NSAGs is a necessary condition for the concentration of armed conflicts in space or time. Internal armed conflicts are coordinated violent movements like the inter-state war. The spatio-temporal concentration of war is a demonstration of the willingness and opportunity of different sides in internal armed conflicts; unlike sporadic fights that might be accidentally caused by unorganized group violence, it takes well-organized institutions to mobilize, finance and command troops to reach the strategic and tactical goals in conflicts. Without NSAGs, there would hardly be coordinated – and thus concentrated – combat events in the battlefield.

Without taking NSAGs into consideration, it is also difficult to capture the dynamics in modern internal conflicts. Some researchers attempt to explain the location of internal armed conflicts using macro-socioeconomic variables such as poverty, road density or population density. However, these variables are (perhaps) sufficient, but not necessary conditions for internal conflicts. Poverty does not necessary "cause" war; at best we may say that poor areas are more inclined to conflicts given certain conditions. And this is also true to variables such as population density, the distance to state capitals, and other similar ones. If population density can be used to explain higher probability of conflict incidence in Africa (Raleigh and Hegre 2009), why don't we see such intense fights in the U.S. Northeast or the Southern part of China? Sprout and Sprout (1965) have reminded us to give attention to the role that the unit (or actor, or "agent" in an agent-structure relationship) plays in the ecological research. An ecological system is comprised of the "environment, environed units, and the interrelations of the two (25)." By relying only upon environmental variables or factors to explain the location or concentration of internal armed conflicts, we would suffer from what Sprout and Sprout (1965) define as "environmental determinism," when we believe that "some set of environmental factors…is sufficient to account for, or to provide a firm basis for predicting" individual behaviors or "the empirical outcomes of their undertakings (48)." Thus, it is important to introduce armed groups into the study of contemporary internal armed conflicts, especially into the geographical aspect of conflicts.

2.3 NSAGS: HOW THEY INTERACT IN SPACE

An armed group in research has multiple definitions. Although according to Norwitz (2008) the term "armed group" is self-explanatory – "armed and group" – itself (xv), the concept includes a spectrum of many different groups in internal armed conflicts. On Norwitz's list (2008), armed groups include "classic insurgents, terrorists, guerrillas, militias, police agencies, criminal organizations, war-lords, privatized military organizations, mercenaries, pirates, drug cartels, apocalyptic religious extremists, orchestrated rioters and mobs, and tribal factions. (xv-xvi).” Coining a new term “violent non-state groups (VNSAs) rather than using NSAGs, Mulaj (2011) excludes police, private military companies (PMCs), criminal organizations but includes terrorist groups in his category (3-5). Vinci (2008) lists several characteristics to define an armed group. An armed group would have

-Leadership with cohesive nature

-Ability to mobilize human and other resources

-Military capability

-Autonomy from the state

-Ability to "commit violence systematically" (which distinguishes them from "small scale criminal groups")

Using the categories above, I define in this research NSAG by including definitions above but exclude PMCs, criminal groups, and violent organizations belonging to or are part of the state (e.g. police, presidential guards, or branches of the state military power)[17]. An armed group seeks to ensure its spatial security; that is, whenever it is possible, an NSAG attempts to control a piece of land on which it can monopolize the use of violence without challenges from other NSAGs, states, or foreign interveners. For those not attempting to control territories, a safe place to ensure their existence and to fulfill the organizational goals (a “safe haven”) is also essential.

Territorial claim is an important aspect in the discussion of geographical space and NSAGs. Territoriality, as define by Sack (1986), is “the attempt by an individual or group to affect, influence, or control people, phenomena, and relationships, by delimiting

[17] However, if the force detaches itself from the state or exists as an ex- or former military forces, it will be included into the NSAG category.

and asserting control over a geographic area (19).” Different NSAGs have different takes on territorial issues. Schneckner (2009) finds that among NSAGs, guerrilla movements, warlords, mercenaries and groups based on clans and ethnicities are more concerned about control over land than criminals and terrorist groups (15-16).

For NSAGs resembling states, or “states-within-states,” a land under total control is necessary for governance and resource extraction or as bases for further expansion. These NSAGs function and behave like governments; for them, the purpose of controlling territory is to ensure their autonomy. Territorial control is also defined by Weinstein (2007) as an indicator for rebels trying to form a government or similar institution of governance (164). According to McColl (1969), revolutionary insurgents establish base areas and use them as the foundation for an “insurgent state” within the state so as to provide “a demonstration of insurgent political and social programs (630).” On the other hand, warlords--another kind of quasi-state armed group-- also seek control over territories (Marten 2003, 48). Many warlords occupy large portions of territory “to reduce non-rebel-related criminal activity and to eliminate rivals for regional power (Spear 2004, 20).” Warlords also “control the relations of sub-groups within its own domain, such as villagers who live within a territory that it controls (Vinci 2008, 299).” Territorial control is more important to highly-organized, state-like NSAGs than to decentralized and loosely-organized NSAGs (Sinno 2008). State-like NSAGs need a cache or “safe haven” to exercise their governance and extract resources from the population so that they can maintain their legitimacy.

For those non-territorial NSAGs, although the occupation of land is not essential, “spatial security” is still important. To survive and operate as an autonomous organization, smaller non-territorial NSAGs also need safe havens. Since they operate in the domain of one or more dominant NSAGs or governments, how to co-exist with those bigger NSAGs and remain active and secure at the same time thus becomes important. In some cases, smaller NSAGs are absorbed into and become parts of a bigger umbrella organization composed of NSAGs of different sizes. For example, the former South Sudan Defense Forces (SSDF) absorbed many small armed groups defined as "Other Armed Groups (OAG)" in the Comprehensive Peace Agreement (CPA) in 2005 (HBSA, 2006). In other cases, smaller NSAGs form alliance with larger ones to protect themselves from being annihilated by their enemies. An example is the Sudan Liberation Movement-Minni Minawi (SLM-MM). The Zaghawa ethnicity-based splinter group from SLM became the target of the Sudanese government in 2010. To protect the group, the leader Minawi sought help from more powerful group Sudan People's Liberation Army-Northern Sector (SPLM-N). (HBSA 2011)

Armed groups of different sizes interact with each other in space. In an anarchic world where there is no or only limited hierarchical authority, more interaction can mean more armed conflicts between NSAGs of different sizes. The inter-NSAG interactions can take place in the following three scenarios:

Quasi States vs. Quasi States: When quasi-state NSAGs interact with each other, it is very similar to international relations (Vinci 2008). They fight over disputed territories or where their control overlapped in space.

Quasi States vs. small NSAGs**:** In another situation, a dominant armed group interacts with other smaller armed groups that have no intention to control territories. When the dominant group faces smaller groups that do not pose threats but might sabotage the "law and order" within the area under its control, battles are also likely to occur. This is especially likely when NSAGs with governance capability attempt to exert their executive and judicial power in the area that they control (see Weinstein 2007; Spears 2004). And if the smaller NSAG resists and fights back with the large NSAG with the intention to control the area, conflicts can be expected.

Different origins, organization goals, and interest groups represented make the conflict between large rebel movements and local community groups very likely. An example is in China in the 1920s. The newly founded Chinese Communist Party (CCP) attempted to infiltrate and encounter the Red Spear Society (Hong Qiang Hui), a community-based rebel group formed by small, land-owing farmers. Armed conflicts took place between the two when the CCP's organizational goal of attacking landlords threatened members in the Red Spear Society (Perry 1980, 217-218).

<u>Small NSAGs vs. small NSAGs:</u> In the scenario where there is no dominant NSAG but are multiple smaller NSAGs, the situation would be worse: smaller NSAGs will fight for control. Some may attempt to form a larger group by forming alliance with each other or by merging with each other. Either of these will increase the probability of conflicts.

2.4 MAIN INDEPENDENT VARIABLES

I use three major independent variables which characterize armed groups - the overlap of areas of operation (AO), the organizational traits of NSAGs, and the strength of NSAGs - to explain the distribution of spatio-temporal clusters of combat events, or major battlefields, in modern internal armed conflicts. Using Most and Starr's research framework (1989), the first and the third variables can be categorized as opportunity, and the second one as willingness. I use Most and Starr (1989) because the dependent variable – the major battlefields of internal armed conflicts – demonstrate both willingness and opportunity of NSAGs.

The areas of operation of NSAGs: NSAGs' areas of operations (AO) are geographical spaces where NSAGs operate. In the center of AOs are armed groups' base areas or "core areas" established as HQs or command centers. Based on Boulding's concept of "loss-of-strength gradient (LSG)", the base area is where the armed group strength remains the greatest. The strength of an armed group diminishes as the distance from the core increases (1962). The area covered and that can be reached by the NSAG's strength is the area of operation. While keeping their core area secure from other armed groups, NSAGs can have overlapping AOs. These are areas where no NSAGs have dominant power.

If there are overlapped areas of operations, there are multiple NSAGs present in a specific geographical area. The probability of conflicts is expected to rise along with the increase of NSAGs, since more opportunities for interaction make conflicts between armed groups more likely. Studies on gangs show that the probability of conflicts is higher along the borders of gang territories (Hazen 2010, 384). That multiple armed groups are in an area also suggests that no dominant armed group can monopolize the use of force. As the number of armed groups increases, each share of space and resources among these groups decreases. NSAGs would then struggle for resources including civilian support, the population for recruitment, and economic endowments. Cunningham (2006) argues that the existence of multiple armed groups makes negotiations and settlement difficult and thus prolongs the conflict process. When there are more armed groups in the conflict, there would be more "veto players" with the incentive not to reach agreements. Reno (2011) also argues that the number of NSAGs is related to longer and enduring armed conflicts. Using the example of Somalia, Reno finds that driven by the incentives to plunder more resources from the outside sources such as NGOs, NSAG leaders or warlords created more armed groups by either splintering from a bigger group or mobilizing for new ones.

That there are multiple armed groups gives the state, neighbor states, and/or other foreign actors the chance to take advantage of such a situation and to intervene by allying with the armed groups that are inimical to the arch rival NSAGs of the intervener. The formation of alliances with armed group by outside actors is often seen in contemporary internal armed conflicts, e.g. conflicts in South Sudan and Darfur. In this vein, the number of NSAGs in a specific area can be viewed as opportunity in Most and Starr's "opportunity and willingness" framework. Opportunity, as defined by Most and Starr (1989), is "the shorthand term for the possibilities that are available within any environment" and "the total set of environment constraints and possibilities" for agents (23). Starr (2002) also subsumes the ease of interaction of international borders under the opportunity category. In my case, what increases the interaction of armed groups is the overlap of their AOs, or the "critical boundaries" of different armed groups.

H1: The more NSAGs there are in a specific area, the more likely the area will become a major battlefield in the internal armed conflict, ceteris paribus.

Organizational traits of NSAGs: If the number of NSAGs in an area represents opportunity in Most and Starr's framework (1989), then another characteristic of NSAG – the organizational traits – can be used to represent willingness. Research on organization behavior in political decision-making concludes that members in organizations have shared and inherited beliefs. The organizational culture determines not only the goals but also the process, including the standard operating procedures (SOPs) and *modi operandi* (Allison and Zelikow 1999; Vertzberger 1990). Non-state armed groups, including liberation movement groups, insurgent groups and separatist groups with different purposes, ideologies and goals are definitely organizations (Ikelegbe and Okumu 2010). Members of rebel movements identify themselves as liberators of the nation, trying to undo and correct the injustice in current systems within the state; they share a philosophy that violent actions towards the state armed forces are justified and effective. On the other hand, members of smaller and provincial armed groups share different organizational cultures. For local armed group members, the most important goal is to protect their community and maximize the interests of their community. These different organizational cultures among armed groups make their choice of strategic goals and tactics, selection of targets and military effectiveness different (Johnston 2008). Cunningham, Gleditsch and Salehyan (2009) also find that civil wars having armed groups with legal political wings as a warring party tend to be shorter and more likely to end up in settlements (581). According to Weinstein (2007), armed groups depending on economic endowments are more inclined to engage in civilian violence than those depending on social endowments. These are examples of how different organizational structures affect the incentives for armed groups to react to each other and the environment. If the armed group is more organized for war and is more militarily capable in its organization, it would be more inclined and willing to solve the incompatibility with other groups via military options. When there are multiple highly organized and militarily capable NSAGs in a place, the incentives for military engagement is expected to increase.

H2: As the number of organized NSAGs increases in a specific area, the more likely that the area will be included in the major battlefield in internal armed conflicts.

The NSAG strength: The strength of NSAGs influences the location where conflicts take place and cluster. In Boulding's "loss of strength gradient (1962)," when the home strength of an actor increases, the boundary of equal strength will be pushed forward (230-231). Based on the same concept, Buhaug (2010) argues that battles in civil wars would take place where the strength levels of warring parties are nearly equal or "comparable (107)." Thus, by measuring the strength of NSAGs in a specific area we can have a potential indicator for the possible location of battles or major battlefields in internal armed conflicts.

It is not easy to measure the strength of NSAGs though. The estimated number of troops is usually used as the major measure of armed group strength, e.g. the IISS Armed Conflict Database and SIPRI conflict data. However, the estimated number of troops is not a good enough indicator not only because it is a rough estimate that changes with time but also because it only measures part of the armed group strength. To measure the NSAG strength locally, I use four indicators instead – the number of NSAGs allying with government, the number of splinter groups, the number of transnational NSAGs and the number of isolated NSAGs in a specific area.

Alliance with governments: in international politics, states can increase their strength either through purchasing more weapons, raising resources internally, or forming alliance with others. So do NSAGs in the intrastate context. Armed groups can ally or merge with other armed groups as the war goes along, or choose to ally and cooperate with governments and receive their financial or weaponry support. Governments are often more organized and have more strength than armed groups. An example is the alliance of Janjaweed and the Khartoum government of Sudan in the conflict of Darfur.

Number of splinter groups: splintering is the reverse process of alliance and merging. Armed group splintering usually occurs when the interests or goals of top leaders diverge, and it decreases the strength of original/mother armed groups. As a result, the more splinter groups are in a specific area, we expect fewer conflicts in that area. However, the splintering process may prolong the conflict process with the increased number of armed groups (Cunningham 2006).

Number of transnational groups: NSAGs that cross different national borders easily are those with more strength. Armed groups can alleviate their strength by getting support from other countries, or preserve their strength by staying in places beyond the reach of the target state government (Salehyan 2009).

The size of AO (measured by the number of isolated groups): the size of an NSAG's area of operation also demonstrates its strength. Large rebel movement groups usually have large AOs that cover large amount of territory in the country, while small NSAGs only operate in places of limited size. Thus, the number of isolated groups can be an indicator of the ecology of NSAGs in a place. When a location is mostly populated with smaller armed groups with limited strength, the probability that the place has prolonged and stretched-out conflict will be lower.

H3: The more there are NSAGs with strength in an area, the more likely that the area will be a major battlefield in an internal armed conflict.

2.5 MEASUREMENT ISSUES AND THE DATA

I use the data from ACLED (Armed Conflict Location and Events Dataset) compiled by Raleigh and Hegre (2005) and Raleigh, Linke and Hegre (2009) with space-time scan statistics by Kulldorff (1997) to operationalize the "main battlefield" concept of magnitude. For visualization and spatial data transformation, geographic information system (GIS) software ArcGIS is used. ACLED contains disaggregated information for each conflict it records. As of July 2010, there were 34 African and Asian countries coded, with data from 2003 to 2009. An internal armed conflict is broken down into events of different categories with geographic locations, dates and warring parties. The point event data in ACLED give researchers greater flexibility to use them. Unlike most statistical data recorded by country or administrative regions, users can aggregate the data points into different study regions or just use them as point data depending on what their research aims are.

Space-time scan statistics and the software SaTScan by Kulldorff (2001) and Kulldorff et al (1998; 2005) is the main statistical method used to detect battle clusters. Scan statistics are widely used in natural sciences to detect possible clusters of events in an area of study. Epidemiologists use scan statistics to detect unusual clusters in a specific study area to find out possible factors that cause the anomaly of distribution or concentration. Scan statistics can be either spatial (cluster on a two dimensional plane) or temporal (cluster along the timeline), or it can be a space-time process (a three-dimensional cluster formed in a space-time dimension). Kulldorff et al (2005) develop the software *SaTScan* to handle data for analysis. The software generates myriads of “windows” using each point event as the center over the surface to discover possible clusters. For spatial scan statistics, the window is 2-dimensional and can be circular, elliptic or rectangular. For the space-time scan statistics, the window is a 3-dimensional cylinder (with time being the height). Each set of data points “bracketed” by any cylindrical window would be compared with the number of data points outside the window to see whether the set of data points within the window makes a “cluster.” Mathematically, it can be written as:

$$\left(\frac{c_W}{\mu_W}\right)^{c_W}\left(\frac{C-c_W}{C-\mu_W}\right)^{(C-c_W)} \qquad (1)$$

where C is the total number of data points in the area of study, defined as

$$C=\sum_i \sum_t c_{it} \qquad (2)$$

C is the sum of all data points (or cases) in different area *i* and time *t*; and c_w is the number of cases that fall into the window *W*; μ_w is the expected number of cases in window *W*, defined as

$$\mu_W=\frac{\sum_i c_{it}\sum_t c_{it}}{\sum_i\sum_t c_{it}},(i,t)\in W \qquad (3)$$

Maximum likelihood would be calculated using (1), and the window that has the highest value is considered the most possible space-time cluster (Kulldorff et al, 2005, 218). A Monte Carlo process is used to test the statistical significance of clusters. I use *SatScan* to run a space-time permutation model with default settings. Clusters are generated using the Monte Carlo (MC) process that generates 999 (or 99 or 9,999) draws. The observed distributions will be compared and ranked with the random sample. For example, if the observed distribution ranks number one among 999 random draws, then the p=0.001. Clusters with P-values above p=0.05 are dropped.

2.6 DEPENDENT VARIABLES: SEVERAL MEASURES ON BATTLE CLUSTER MAGNITUDE

Internal Combat Events (ICE) spatio-temporal clusters, also defined as the "major battlefields" in internal armed conflicts, are estimated using SaTScan. Three types of events are used--combat in which the state wins, combat in which the rebel wins, and combat events in which there are no winners. These are military engagements between different actors including governments and armed groups. Other types of events are omitted because they are not classified as ICEs.

There are four indicators for the measurement of local battle magnitudes:

-The incidence of ICEs

-The presence of at least one ICE cluster in the area

-The number of total ICE clusters that ever appeared in the area

-The ICE cluster of the longest duration in the area

ICE incidence (logged) in each cell is used as a baseline for comparison. The other three indicators for measuring dimensions of the intensity of conflict at the local level include: the presence of ICE clusters, number of ICE clusters in each cell, and the longest duration of ICE cluster in each cell. The presence of ICE clusters is a dummy variable. If there is at least one ICE cluster is recorded in a cell the value is one, or zero otherwise. ICE density in each cell is calculated by counting numbers of ICE in each cell and taking logs on the numbers. The number of ICE clusters/cell counts the number of ICE clusters with different durations and geographical scope. The duration of ICE cluster variable records the number of years of duration of the longest ICE cluster in each cell. These variables are designed to capture different dimensions, temporally and spatially, of battle intensity.

Spatial data are handled and generated using ArcGIS 10, the latest version of ArcGIS software. The unit of analysis is grid-year. The earth's surface is divided into grids with the grid size used here set to be 50-by-50 kilometers. There is no conventional rule for setting the sizes of grids. It is a trade-off between resolution of data and efficiency. Buhaug and Rød (2006) set their grid size to be 100km-by-100km while Raleigh and Hegre (2009) set their gird size to be 8.6km-by-8.6km. Finer grids can record smaller variations but will inevitably expand the dataset and make the running of statistic models slower or even infeasible. By setting the size of grid 50km-by-50km, it is assured that the smallest country can be covered by more than one grid so that the variation can be kept.

Measuring the AO/how to estimate the areas of operation of NSAGs: the area of operation of an armed group is an estimated polygon using the known recorded geo-referenced events in the ACLED data. Each battle event is shown as a dot on the map. ArcGIS 10 connects the dots with lines in a temporal sequence within a year. A buffer of 20 km is added to each plane to form the estimated area. Temporally the "t-1" events are used to estimate AOs to avoid simultaneity.

Organizational levels of armed groups: I use the categories developed by the Uppsala Conflict Data Program's (UCDP) Actor Codebook (2011). UCDP classifies non-state actor as three types. Level 1 organizations include "formally organized groups" that are highly organized with an announced name. Level 2 organizations are "groups composed of supporters and affiliates to political parties and candidates" that are temporarily organized for combat or electoral violence. Level 3 organizations are informal and less-organized groups formed along "ethnic, clan, religious, national or tribal lines" and are usually involved into communal strife (11-12).

Control/ "Environmental" Variables: I include several environment and physical data sources to use as control variables. These variables include those used in current research to explain the location of conflicts in modern civil wars, or those theoretically or potentially related to the location of conflicts.

Development: using the Liberian Civil War case, Hegre, Ostby and Raleigh (2009) find that conflicts tend to concentrate in richer areas. From the "grievance" perspective, poverty and underdevelopment are positively related to the incidence of civil wars. The data used to measure poverty are obtained from the DMSP-OLS Nighttime Lights Time Series project from the National Oceanic and Atmospheric Administration (NOAA). The project offers nighttime light images taken by satellites since 1992, as various research projects use the brightness of lights as a proxy for development (Sutton et al 2009).

Accessibility/transportation: This variable is used to substitute the road density used in other research for accessibility (Raleigh and Hegre 2009). Places more easily accessible generally have better road construction, meaning more state penetration and presence. Therefore, this indicator of accessibility is expected to negatively related to the incidence of conflict, fewer ICE clusters and shorter clusters. I use the Human Influence Index dataset compiled by CIESIN at Columbia University. The project uses 8 categories to estimate the human presence in a place, including road density. The limitation here is that the data are from 2005 only.

Border-crossing ethnicity: international ethnic groups dwelling along country borders might facilitate the influx of refugees and thus creates a channel through which conflicts can spread. This environmental indicator is a dummy variable that records places having at least one cross-border ethnic group. I use the *Geo-referencing Ethnic Group* (GREG) dataset compiled by Weidmann et al. (2010) to calculate the number of ethnic groups in each cell before turning them into a dummy variable.

Border buffer of 100km: Many contemporary internal armed conflicts in Africa took place along state borders, such as the Darfur Conflict (near the Sudan-Chad border) and the conflicts in DRC's Kivu region (near the DRC-Rwanda-Burundi border). Borders are often used by armed groups as sanctuaries during the war (Buhaug and Rød 2006). Rebel groups also take the economic advantage of borders, using them as transaction centers or extract natural resources along the national borders (Le Billon 2001). So the likelihood of battle event occurrence is expected to be higher than other places within the country. As a result, the border area is included as a control variable. The buffer zone is generated using ArcGIS 10 on the map.

Forest: Fearon and Laitin (2003) attribute the increased years of duration of civil wars to forest, since forest offers great caches for rebels to hide. Following their logic, I expect a positive relationship that it is more likely to see major battlefields in internal armed conflicts because rebels could have battles with government troops conducting search-and-destroy missions over there. The dataset is generated using Anthromes Project (Ellis and Ramankutty 2008), in which the earth surface is categorized into different anthropogenic biomes. I extract "populated forests" and "remote forests" to combine them into a dummy variable.

The resource indices: natural resources are regarded to increase the probability of civil wars, as conflicts tend to concentrate near where the natural resources are, such as diamond, oil or others (Hegre, Ostby and Raleigh 2009). However, each country has its idiosyncratic resource, thus it is not easy to come up with a standardized list of such resources. I use the sum of gross domestic product (GDP) in the cell as the proxy of economic resources, and the population per cell as the proxy of human resources instead. These two values represent potential resources that NSAGs can extract from the cell where they are in. I take the population data from the Gridded Population of the World Project of Columbia University (CIESIN 2005). The cell GDP is calculated by multiplying the national GDP data obtained from the United Nations with the population within the cell. Both values are taken log to make the distribution smoother.

Previous combat events: this autocorrelation variable records the number of combat events having taken place in the previous year. There are three categories of combat events in ACLED (Raleigh, Linke and Hegre 2010): battles won by governments (governments reclaim the territory), battles won by rebels (rebels retake the territory), and ties (no territory transfers). Each category is used as an independent variable in the models. I use previous government victories as an indicator of overall government strength and control in the specific area, as I expect to see that more previous government victories would lead a decrease of combat events in the following year since the government has more control. Furthermore, the more there are ties in a place, the more probably that the place will see combat events in the next year.

Econometric Models: Binary time-series cross-sectional models and the Hausman-Taylor model are used to estimate results. For the BTSCS model, splines are added as suggested by Beck and Katz (1997). The Hausman-Taylor model is used to handle possible endogeneity issue among independent variables especially while some of the IDVs are time-invariant (Cameron and Trivedi 2009, 284). The master dataset is subjected to spatial autocorrelation, thus spatial lag needs to be controlled for in models (Ward and Gleditsch 2008). The spatial lag variable is generated using Jeanty (2010) respectively for the dummy of ICE cluster/battlefields, the logged incidence of ICEs, the number of ICE clusters and the maximum year of ICE cluster duration.

2.7 INTERPRETING THE RESULTS

Number of NSAGs and MB: The TSCS logistic model (Model 1) shows that the number of NSAGs increases probability of the spatio-temporal cluster incidence (see Table 2.2). Each NSAG increase in the cell contributes to around 57% of cluster incidence. The number of transnational NSAGs has more effects on the incidence of ICE clusters: each transnational NSAG increase would make the probability of ICE clusters to raise around 231%. As for other strength-related variables, each presented isolated NSAG would reduce the ICE cluster incidence by 71.2%, while each of the government-allied NSAG increase the rate by 82%. The splintering variable, however, is not statistically significant.

The finding that more NSAGs in a specific location contribute to battle cluster concentration in civil wars can be further illustrated by Figure 2.1. Three major spatio-temporal clusters, or major battlefields, concentrated along the border between the Democratic Republic of Congo (DRC), Rwanda and Uganda in the Kivu region in 2006 (the purple circles). Areas included in major battlefields are where the most intense battle events took place. Combining the major battlefields layer with the raster layer that shows the density of NSAG in the 50km-by-50km cells in 2005, we can see that major battlefields are overlapped areas of operation where there were most NSAGs.

As for the environmental variables, places included in the 100km border buffer zone would be 74% more likely to be a major battlefield in contemporary internal armed conflicts. Places where transnational ethnic groups are present are 30% more likely to be major battlefields. Locations with greater accessibility almost make no difference in becoming the battlefield, and the more developed areas (represented by NASA nighttime light) are slightly less prone to be covered by ICE clusters. Forest areas, which may lead to higher probability of conflict incidence at the state level (Fearon and Laitin 2003), render no statistically-significant effects on local conflict presence.

Resources indicators measured by the sum of GDP per cell and the sum of population per cell (both in the log forms) are also positively related to the presence of an ICE cluster or ICE clusters in the place (respectively 22% and 26% increase). For temporal lag variables, places that have experienced conflicts in the previous year have slightly higher probability to be battlefields. However, whether the government or the rebel group has more victories in the previous year does not seem to matter.

Model 2 (log battle number per cell), Model 3 (number of ICE cluster per cell) and Model 4 (longest duration of ICE cluster per cell) demonstrate the results in different measures of local ICE intensity. Areas harboring more NSAGs are more likely to have more conflicts, more intense conflicts and longer conflicts, so are areas where there are more transnational NSAGs (Table 2.3). On the other hand, places with more geographically isolated NSAGs are less probable to have intense and enduring conflicts, although the effect on the number of battles per cell is not statistically significant.

Effects of splintering among armed groups--often seen in many contemporary internal armed conflicts in Africa—are diverse. Places with more splinter groups/NSAGs are less likely to have intense combat clusters, but such places would see more longer ICE clusters, i.e. the battlefields with long duration, instead. The result corresponds to my hypothesis that due to the lack of the monopoly of power, place with splinter groups would have fewer clusters and combat events in these clusters would be more sporadic. However, based on Cunningham's findings drawing upon the "veto player" thesis (2006), conflicts would progress longer in places with multiple splinter groups than those without.

Environmental variables also demonstrate different effects in Models 2, 3, and 4 than Model 1. Areas near and along borders tend to have higher ICE incidence rates and are more prone to have more and longer ICE clusters. Areas with at least one cross-border ethnic group tend to have clustered and enduring conflicts, but the effects that the location of transnational ethnic groups has on the incidence of ICE are not statistically significant.

Both development (NASA nighttime light) and accessibility (HII2005) have no statistically significant effects on the incidence, intensity and duration of internal combat events. Interestingly, forest coverage has negative effects in all three models, which is not only opposite to results from Model 1 but also contrary to what Fearon and Laitin (2003) have hypothesized at the state level that forest vegetation contributes to higher incidence rate of civil wars.

Resource variables, however, display non-concordant results. GDP per cell has positive effects on both the intensity and duration of ICE but has negative influence on incidence, while population per cell displays the opposite effects. All temporal lag variables—the number of state victories, rebel group victories and ties between the government and rebels in the previous year—have a positive influence on either the incidence, intensity and duration of ICE. However, more government victories in the previous year do not guarantee peace; on the contrary, the more battles were won by the government in the previous year in an area, the more likely the place will attract not only more but also more clustered and prolonged conflicts in this year.

Organizational structures of NSAGs and MB: Various organizational levels make a difference on the distribution, concentration and duration of conflicts. Model 5 shows the effects of organizational characteristics on the presence of ICE clusters. There is a huge difference between different types of armed organizations. As the number of level-1 NSAGs increases by one, the probability that the place becomes a major battlefield in the civil conflict increases by 479%. Each presence of an ethnic, religious or local NSAG increases the probability by around 77%. However, although overall also increasing the probability, level 2 organizations—the political organizations—contribute the least. The findings correspond to what Cunningham, Gleditsch and Salehyan (2009) have found that political institutions help to reduce the probability of conflicts at the state level.

Model 6, Model 7 and Model 8 show similar results that level 1 NSAGs contribute the most on either the incidence of ICE (Model 6), the number of ICE clusters (Model 7), or the duration of ICE clusters (Model 8), while the increased numbers of level 2 NSAGs contribute the least on the likelihood for a place to become the major battlefield in civil strife (Table 2.4).

Returning to our hypotheses, we see that the first hypothesis--that the increasing numbers of NSAGs in a place raises the probability of longer and more ICE clusters--is best supported. The number of NSAGs in the previous year in the local area demonstrates a strong consistency of effects respectively on the incidence of ICEs, the presence of ICE clusters, the number of ICE clusters and the duration of longest ICE cluster. H2 is also well supported as the effects of NSAG organizational traits on various measures of battle intensity show a clear sequence, i.e. highly militarized organization groups>smaller and less organized armed groups>political institutions. We can see that if the organization is essentially political, the likelihood of intense and prolonged ICE clusters will be fewer in number than if the organization is highly military organized or formed as a violent group. This result suggests that organizational traits, or the “identity” of NSAGs, influence the choice of tactics and strategies and help to reduce the spatial and temporal conglomeration of combat events.

Figure 2.2 and Figure 2.3 visualize a contrast how non-state armed groups with different organization traits would determine the location of major battlefields in internal armed conflicts. Map 2 shows a concentration of battle event clusters along the border of

Uganda and Sudan in 2002. In 2001, multiple NSAGs were found active in this area, and more importantly, these groups were almost highly organized and militarily capable organizations. Increased proportion of Level 1 NSAGs in this area is apparently associated with the concentration of battles.

Figure 2.3 shows the negative effects of Level 2 NSAGs (political institutions) on the likelihood that a place would become major battlefields in civil wars. The vast area west to the Kivu region of the Democratic Republic of Congo was the active area of level 2 NSAGs, and no major battlefields were found in the next year. Major battlefields of 2002 were found in places such as the Uganda-Sudan border area or the Rwanda-Burundi-Kivu region where the majority of active armed groups are level 1 organizations.

NSAG Strength and MB: The NSAG strength related H3 is partly supported by the TSCS model results. Results are mixed as effects vary among different indicators. Numbers of splinter groups and geographically isolated groups generally demonstrate negative effects on various aspects of ICE intensity except in Model 4, where the number of splinter groups has a positive effect on the duration of ICE cluster. The transnationality of NSAGs generally increases the probability of battle intensity. Alliance with governments demonstrates positive effects on battle intensity while modeled with the number of NSAGs, but negative effects with different organizational types of NSAGs.

Figure 2.4 shows the relationship between local strength indicators and the concentration of battle events in the spatio-temporal dimension in South Sudan from 2001 to 2002. An index of local armed group strength is made using the four independent variables—number of splinter NSAGs, number of isolated NSAGs, number of transnational NSAGs and number of NSAGs having alliances with governments—and visualized using ArcGIS 10. The case of South Sudan shows that the higher strength index levels are in a place, the more likely that the place would become the major battlefields of war in the next years.

It is surprising to find that the number of government victories in the battlefield causes more violent in the next year in the same place. This result may show that government victories cannot ensure security. It is also possible that the indicator is flawed and may need further clarification and better design. I may need a better indicator for the consolidation of government control, e.g. to use peace years or the streak of winning years.

2.8 CONCLUSION

By conceptualizing the areas of operation of NSAGs, this research shows that two "opportunity" variables—the number of NSAGs and the strength of NSAGs in a place—and one "willingness" variable—the organizational characteristics of NSAGs in a place can explain the location of major battlefields in civil wars. Based on Sprout and Sprout (1965), this research assumes the battle zone to be an ecological system, in which non-state armed groups are the major actors contributing most to the occurrence and location of the most intense battle events. To explain the location of wars, we should not just focus on environmental factors that may fail to capture the variations and dynamics seemingly unexplainable but actually can be explained by variables at the agent/actor level such as NSAGs.

Although this research is not the first attempt to explain the location of war using armed groups, but it is the first one that uses the sub-state level unit of analysis and data to explore the relationship between NSAGs and the spatio-temporal location of civil wars. Buhaug (2010) argues that rebel strength explains the location of civil wars (using the measure of distance between capital and the warzone): the more power that the rebel group has, the closer the war would be to the capital. By extending Buhaug's research findings, my research goes further and explains where the most intense battles take place at the sub-state level. Besides, with the help of GIS, the location of major battlefields in civil wars is not only able to be indicated precisely but also visualized using maps. I use major battlefields (MB) for the location of war in civil wars. Compared with the "scope" of war by Buhaug and Rød (2006), the major battlefields are more dynamic and can capture more precisely the essence of changing battle zones in different phases of contemporary civil wars, as elaborated in the first article of my research.

By breaking down the unit of analysis to the sub-state level, my research finds that the local balance of power between NSAGs and strength of NSAGs can explain the location of major battlefields in civil wars. This finding is an extension from Boulding (1962) that the relative strength between different parties determines the location of conflict. Furthermore, using Most and Starr's "opportunity and willingness" framework (1989), I also find that the willingness factor—the organizational difference among NSAGs—plays an important role in locating the explaining battles in civil wars. These findings not only contribute in the context of geographical and scientific research of war but also have practical values. The factors that I use to explain the location of major battlefields are dynamic (e.g. the number, strength and organization traits of NSAGs), As a result, they can be used as indicators when practitioners such as IGOs, NGOs and international humanitarian organizations observe the process of civil wars and make decisions for policy implementation.

Table 2.1: List of Independent Variables

Variables	What they are	Expected Influence on the location and intensity of main battlefields
Number of NSAG, in the previous year (t-1)	The number of AGs in the 50-by-50km cell in the previous year of measured conflict.	+
Number of Level 1, 2 and 3 NSAG, t-1	The composition of AGs of different organization levels in the previous year.	+ - +
# of alliances with gov, t-1	The recorded number of alliances among AGs of different org levels and governments.	+
# of transnational NSAG, t-1	The number of armed groups engaging transnational activities in the cell.	+
# of splinter NSAGs, t-1	The number of splinter armed groups in the cell.	+
# of isolated NSAGs, t-1	The number of isolated armed groups in the cell.	-
Border 100km bufferzone	Whether the cell is in the 100-km buffer zone of international borders.	+
NASA nightlight index, t-1	The value of nightlights using the NOAA data. Represents development and the level of poverty.	-
HII2005	The human influence index of 2005. Indicates accessibility and intensity of human activities.	-
forest	Whether a cell is a forest area.	+

Table 2.1 (Continued): List of Independent Variables

Transnational Ethinic group (dummy)	There is at least one transnational ethnic group in the cell (=1); otherwise 0.	+
Gov wins, t-1	The number of government victories in the previous year.	-
Ties, t-1	The number of battles involving no change of territories between the govs and AGs in the previous year.	+
NSAG wins, t-1	The number of AG victories in the previous year.	+
GDP in grid logged, t-1	The accumulated GDP of the cell in the previous year.	+
Population in grid (logged), t-1	The smoothed population estimation of the cell in the previous year.	+
Splines	Splines created for –xtlogit- according to Beck and Katz (1997).	?
Transnational Ethinic group (dummy)	There is at least one transnational ethnic group in the cell (=1); otherwise 0.	+
Gov wins, t-1	The number of government victories in the previous year.	-
Ties, t-1	The number of battles involving no change of territories between the govs and AGs in the previous year.	+
NSAG wins, t-1	The number of AG victories in the previous year.	+
GDP in grid logged, t-1	The accumulated GDP of the cell in the previous year.	+
Population in grid (logged), t-1	The smoothed population estimation of the cell in the previous year.	+
Splines	Splines created for –xtlogit- according to Beck and Katz (1997).	?

Table 2.2: Model 1 and Model 5

Variable	**MODEL 1**	**MODEL 5**
	ICE cluster? (dummy)	
Number of NSAG, t-1	0.4541***	
# of Level 1 NSAG, t-1		1.7576***
# of Level 2 NSAG, t-1		0.3402*
# of Level 3 NSAG, t-1		0.5705***
# of transnational NSAG, t-1	1.1980***	-0.0371
# of alliances with gov, t-1	0.6039***	0.2687***
# of splinter NSAGs, t-1	-0.0320	-1.2976***
# of isolated NSAGs, t-1	-1.2419***	-1.6393***
Border 100km bufferzone	0.5581***	0.5808***
NASA nightlight index, t-1	-0.0777*	-0.1100**
HII2005	-0.0001**	-0.0001*
Forest	0.0408	0.1313
Transnational Ethinic group dummy	0.2606*	0.0809
Gov wins, t-1	0.0494	-0.0003
Ties, t-1	0.0150*	0.0250***
NSAG wins, t-1	0.0225	0.0747
GDP in grid logged, t-1	0.2027***	0.2215***
Population in grid (logged), t-1	0.2328***	0.2154***
_spline1	0.0710***	0.0747***
_spline2	-0.1043***	-0.1064***
_spline3	0.0950***	0.0946***
Constant	-10.9033***	-10.9890***
legend: * p<.05; ** p<.01; *** p<.001		

Table 2.3: Model 2, Model 3, and Model 4

Variable	**MODEL 2**	**MODEL 3**	**MODEL 4**
	Number of ICEs	Number of battle clusters	Duration
Number of NSAG, t-1	0.0128***	0.0124***	0.0475***
# of transnational NSAG, t-1	0.0520***	0.0420***	0.0819***
# of alliances with gov, t-1	0.0082***	0.0026	0.0136**
# of splinter NSAGs, t-1	-0.0092**	-0.0072**	0.0341***
# of isolated NSAGs, t-1	-0.0046	-0.0467***	-0.1445***
Border 100km bufferzone	0.0171***	0.0189***	0.0690***
NASA nightlight index, t-1	0.0011	0.0007	0.0016
HII2005	-0.0000	0.0000	0.0000
Forest	-0.0314***	-0.0431***	0.1545***
Transnational Ethinic group dummy	-0.0041	0.0071**	0.0443*
Gov wins, t-1	0.0462***	0.0158***	0.0419***
Ties, t-1	0.0089***	0.0050***	0.0091***
NSAG wins, t-1	0.0072*	0.0060*	0.0251***
GDP in grid logged, t-1	0.0184***	-0.0279***	-0.2297***
Population in grid (logged), t-1	-0.0089***	0.0187***	0.1465***
Spatially lagged variable: battle numbers per cell	0.4026***		
Spatially lagged variable: # of ICE clusters		0.7229***	
Spatially lagged variable: max duration in years			0.6598***
Constant	-0.2507***	0.1364***	1.8175***
legend: * p<.05; ** p<.01; *** p<.001			

Table 2.4: Model 6, Model 7 and Model 8

Variable	**MODEL 6**	**MODEL 7**	**MODEL 8**
	Number of ICE	Number of battle clusters	Duration
# of Level 1 NSAG, t-1	0.0505***	0.0567***	0.1082***
# of Level 2 NSAG, t-1	-0.0006	0.0101**	0.0399***
# of Level 3 NSAG, t-1	0.0305***	0.0177***	0.0456***
# of transnational NSAG, t-1	0.0172***	0.0038	0.0120*
# of alliances with gov, t-1	-0.0058*	-0.0134***	-0.0127**
# of splinter NSAGs, t-1	-0.0397***	-0.0411***	-0.0337***
# of isolated NSAGs, t-1	-0.0157**	-0.0595***	-0.1571***
Border 100km bufferzone	0.0174***	0.0190***	0.0702***
NASA nightlight index, t-1	0.0012	0.0008	0.0021
HII2005	-0.0000	0.0000	0.0000
Forest	-0.0305***	-0.0428***	-0.1515***
Transnational Ethinic group dummy	-0.0063	0.0061*	0.0338
Gov wins, t-1	0.0471***	0.0153***	0.0457***
Ties, t-1	0.0094***	0.0052***	0.0104***
NSAG wins, t-1	0.0085**	0.0072**	0.0321***
GDP in grid logged, t-1	0.0185***	-0.0311***	-0.2304***
Population in grid (logged) , t-1	-0.0099***	0.0208***	0.1416***
Spatially lagged variable: battle numbers per cell	0.4132***		
Spatially lagged variable: # of ICE clusters		0.7166***	
Spatially lagged variable: max duration in years			0.6547***
Constant	-0.2444***	0.1664***	1.8826***
legend: * p<.05; ** p<.01; *** p<.001			

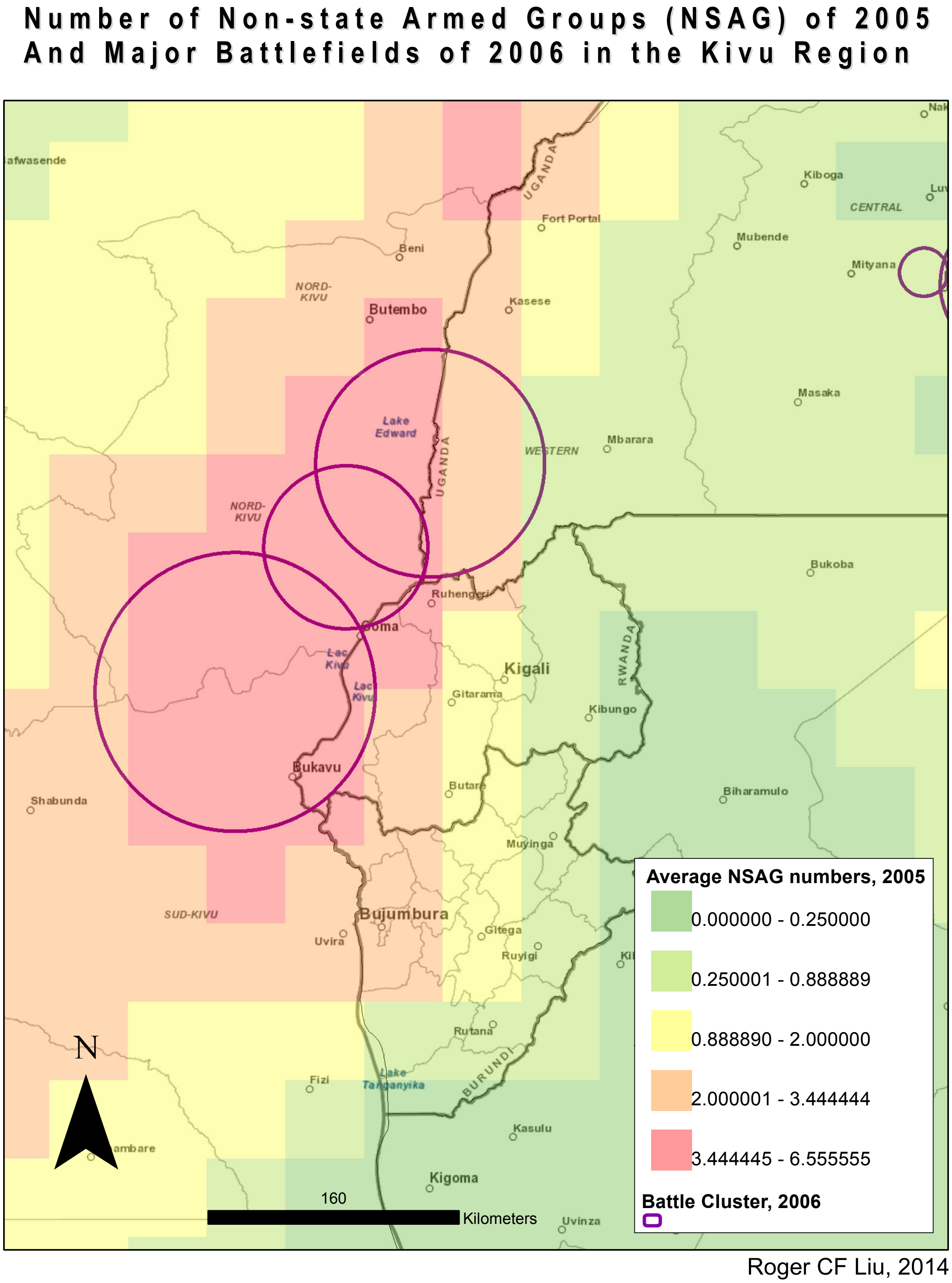
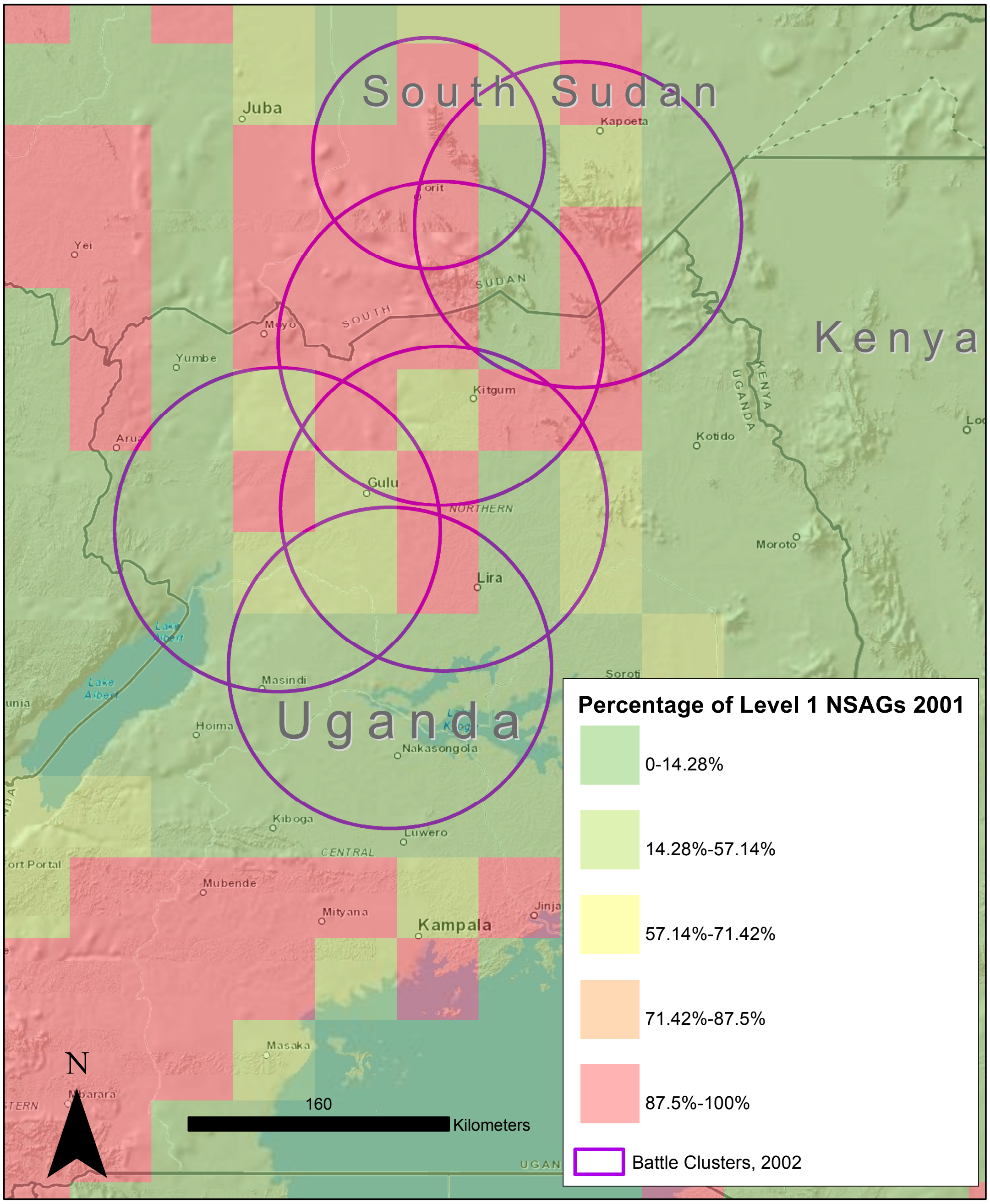


Figure 2.1: Number of NSAGs of 2005 and Major Battlefields of 2006 in the Kivu Region

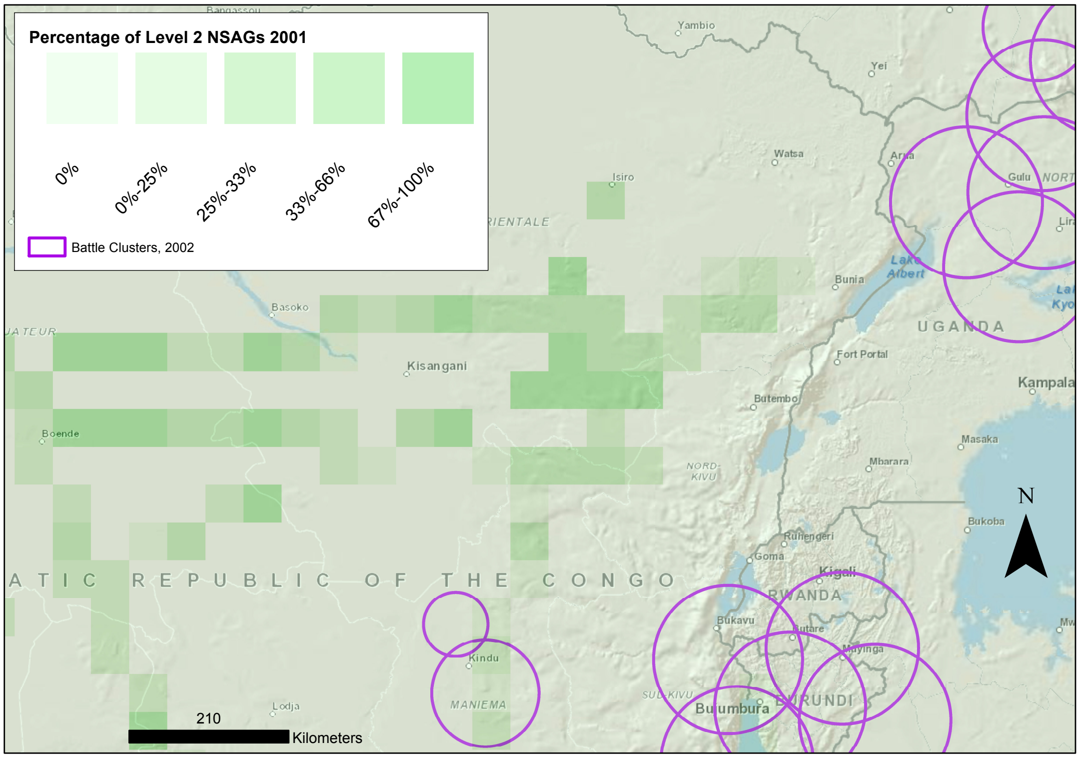
Percentage of Organization Level 1 NSAGs of 2001 and Battle Clusters of 2002 in Northern Uganda and South Sudan



Roger CF Liu, 2014

Figure 2.2: Percentage of Organization Level 1 NSAGs of 2001 and Battle Clusters of 2002 in Northern Uganda and South Sudan

Percentage of Organization Level 2 NSAGs of 2001 and Battle Clusters of 2002 in Sub-Saharan Africa



Roger CF Liu, 2014

Figure 2.3: Percentage of Organization Level 2 NSAGs of 2001 and Battle Clusters of 2002 in Sub-Saharan Africa

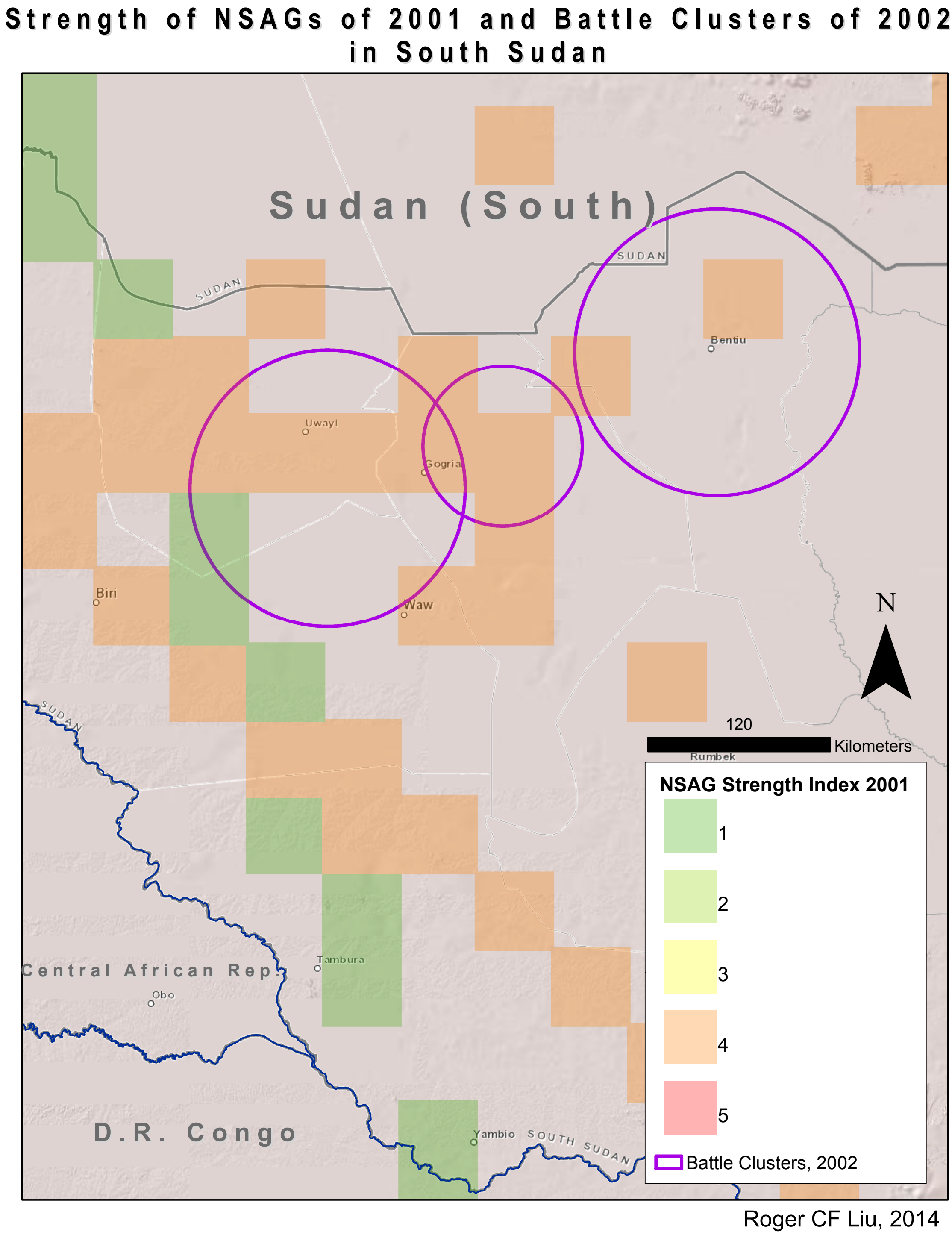


Figure 2.4: Strength of NSAGs of 2001 and Battle Clusters of 2002 in South Sudan

CHAPTER 3:

“TERROR IN THE WAKE OF WAR: ARE MAJOR BATTLEFIELDS OF CIVIL WARS MORE LIKELY TO BREED TERRORISM?”

How do we discover and explain the location of terrorist attacks in the context of civil wars? This question becomes more important especially when there is a growing literature on the relationship between terrorism and civil wars. Terrorism, as a major kind of tactics that rebel groups use, coexists with civil wars. The battlefields of civil wars create favorable incentives and outer structure for breeding more terror (Sambanis 2008). Armed groups in internal armed conflicts use terrorist attacks to pressurize the government for more concessions (Stanton 2012; Pape 2005) as well as to spoil the peaceful resolution by prolonging the conflict process (Findley and Young 2012).

On the other hand, there is a growing literature on the geographic distribution of terrorism. Terrorist attacks are found clustered in space and time (Bahgat and Medina 2013; Findley and Young 2012; Webb and Cutter 2010; Braithwaite and Li 2007; Smith et al 2006) as other researchers attempt to predict or explain terrorism using socio-economic variables (LaFree and Bersani 2012; LaFree et al 2012). However, there is a lack of explanation for terrorism taking place in the context and the process of contemporary internal armed conflicts. In my first article, I find that battles in civil wars also cluster spatially and temporally. If civil wars create a favorable environment for terrorism, while at the same time both forms of political violence cluster in time and space, can we explain the incidence, severity and formation of terrorism using spatio-temporal battle clusters, or "major battlefields", of civil wars?

The answer is yes. The purpose of this research is to find out where the major battlefields in contemporary internal armed conflicts are, and whether the proximity and duration of these major battlefields make the incidence of terrorism – a category close to but different from civil wars and guerrilla warfare - more likely. In this article, I show how major battlefields--or spatio-temporal battle events clusters--in civil wars influence terrorism in the context of civil wars. I find that the density and duration of major battlefields in civil wars contribute to the incidence and severity of terrorist events during and after the war. The more "condensed" a major battlefield is, i.e. there are more battle events occurring in the battlefield temporally or geographically, the more likely that terrorist events would take place during or after the conflict. In addition, the longer a place has been a major battlefield in the civil war, the more likely that there would be terrorism in that place. Finally, the condensed and prolonged major battlefields would also contribute to more casualties in terrorist events during or after the war. I explain the effects in the following ways. First, according to the "first law of geography" near things are more related to each other. As a result, the havoc generated by armed conflict will be more direct and severe in or near the major war zones than other places. Second, major battlefields in civil wars indicate the lack of control of either the government or non-state armed groups (NSAGs) over that specific area. The government and the rebels both need to secure the support from local people politically and militarily, and both sides need the information that can be more readily gathered with popular support. The lack of control on either side means the constant shift of loyalty and allegiance of the people in the war zone, as this situation would generate incentives for both sides to engage in indiscriminate violence, i.e. terrorism. Third, researchers have found that terrorism is usually used as tactics by both sides during the civil war; concentrated battlefields thus would be more likely to breed terrorist attacks. Finally, major battlefields would increase the severity of terrorism by brutalizing, polarizing and routinizing violence in the localities. However, direct terrorism attacks towards civilians will generally diminish as civil war proceeds.

3.1 THE DIFFERENCE BETWEEN TERRORISM AND CIVIL WAR/GUERRILLA WARFARE

Battles in civil wars and terrorist attacks are conceptually different. To differentiate these two concepts is essential. The official definition of terrorism by the United States appears in the US Code Article 22, Section 2656f(d) as a "premeditated, politically motivated violence perpetrated against noncombatant targets by subnational groups or clandestine agents, usually intended to influence an audience." Although terrorists and insurgents/guerrillas in civil wars may share similar goals (Sambanis 2008), the two separate kinds of political violence differ in many aspects. The operational modes, or the conduct of warfare, of terrorism and civil wars are different. Terrorist attacks are mostly conducted by clandestine individuals in very small units. Terrorists use bombs or self-made explosives to conduct assassinations or suicide attacks, while in civil war guerrilla forces imitate modern military ranks and organizational structures and use conventional weapons (Merari 2007). Unlike guerrilla forces, terrorists usually don't occupy territories and seldom seek support from the people (Sanchez-Cuenca and De La Calle 2009; Hoffman 2006). Terrorism has lower levels of violence when terrorists focus mostly civilians as their targets (Sambanis 2008). Terrorism and civil wars are caused by different social and economic conditions and factors. Poverty plays an important role in the cause of contemporary civil wars (Collier and Hoeffler 2004) but not in terrorism (Krueger and Maleckova 2002).

3.2 HOW CIVIL WAR BATTLEFIELDS BREEDS TERRORISM

There are three approaches about how civil wars trigger and breed terrorism. First, terrorism is often used as strategies in civil wars by armed groups. Second, terrorism is used as a tool to control and ensure the compliance of local population. Third, terrorism is a product from the post-conflict society in which the original socio-political structure has been destroyed by war.

The "terrorism used as tactics" mechanism*:* A causal link between civil wars and terrorism is that armed groups and individuals in civil wars use terrorist attacks as strategies. Merari (1993; 2007) and Kydd and Walter (2006) list five strategies of terrorism used in the course of civil wars: provocation, attrition, intimidation, outbidding and spoiling.

Provocation: terrorists provoke the government by launching attacks to lure the government to repress in response. When the government's counterterrorism responses do harm to the local people, it then sends a message, especially to the moderate population, that the government is evil and ineffective and should be substituted by a better regime (Kydd and Walter 2006, 69-70). Merari (2006; 1993) also reports that right-wing insurgents tend to use the provocation strategy to show the public the ineffectiveness of the weak liberal government. By doing so the insurgency group intends to persuade the public to support a strong and more repressive regime (35-36).

Attrition: this strategy is used on the adversary. By imposing extra costs on the enemy, the perpetrators aim not only to drain the government's strength by terrorist attacks, but also to send out messages to the enemy that the insurgent group is still determined and capable of continued combat (Kydd and Walter 2006, 59-60; Merari 2007, 36).

Intimidation: by applying this strategy perpetrators aim to get local population's cooperation and support. Attacks can be directed towards the government. Tactics such as assassination can be taken towards individual government officials and their families. Terrorist attacks are intended to not only to spread fear among the adversary but also to expose to the audience the impotence and weakness of the government. Terrorism can also be directed towards to the local population to force them to "take a stand." To make local population to comply with the insurgent group's aims and needs, the violence is usually selective and towards those refusing to cooperate with the rebel and assist the government (Merari 2007, 34; Kydd and Walter 2006, 66).

Outbidding: when there is a lack of information about two or more competing groups in civil wars, insurgent groups tend to launch terrorist attacks to signal the local population that their group is the more determined and capable one (Kydd and Walter 2006, 76). In Merari's term, this is the "propaganda by deed": by letting more people know the insurgency group's ideas, this strategy aims to spark a larger movement (2007, 33).

Spoiling: this strategy is usually used at the end of armed conflict when there is a prospect of peace agreements and truce. By launching terrorist attacks, the hawkish faction within the rebel can sabotage the potential reconciliation between the government and moderate factions by creating mistrust among them. On the other hand, this strategy is also aimed to signal the government that the moderate faction is not the party who has the final say in the process of conflict (Kydd and Walter 2006, 72-73).

To conclude, in the process of civil wars, a variety of non-state armed groups use different terrorist tactics and strategies to support their goals in war.

“Destruction area”/the aim to control/geographical difference of violence: One important reason that terrorism is adopted as strategies and tactics in civil wars is the control over local population. But where does terrorism take place? Some locations tend to have more violence than others. The perpetration of violence by armed groups aims at two goals: compliance from local population and destruction of local support for the enemy. If an armed group has higher level of control over the local population in a specific area, the less likely that armed group would choose selective violence as a tool. This also applies to the government side and troops in civil wars (Kalyvas 2004).

For both government and the rebel armed group, their strength and control are the highest in their “home bases.” As distance grows from the core of their strength, the capability of control diminishes. In areas where none of the warring parties can exert predominant or effective control over the local population, the incentives to resort to “indiscriminate violence” for either the government or the rebel group would increase (Kalyvas 2006, 202-206).

Another essential factor that influences the adoption of violence on civilians is information about the political loyalty of the local population. In their home bases, armed groups know that the local population support them and are willing to comply. As a result, the need and incentives to use violence for control are less likely to appear. However, in places where armed groups have lower levels or even no control, incentives to use violence on civilians increase. It is more so in vital locations with high strategic value such as big cities, villages of important resources or places of military value. In places where no one armed group has predominant control, each group does not have enough information about political loyalty. An armed group does not know whether the local population only support itself or the enemy at the same time, nor the local population are only artificially complying.

In areas where neither side has effective control, argues Kalyvas (2006), either the government or the rebel group tend to resort to "indiscriminate violence"; however, in places where each side has only fragmented control, "selective violence" is preferred. Behind choices of different violence towards civilians are different levels of information accessibility and goals of armed groups. When most of the local population is loyal and compliant with only a small portion of "fence-sitting" people, armed groups use selective violence to control and govern, and make sure all local population will comply. But when there is a lack of information about political loyalty in a specific place, armed groups tend to use indiscriminate violence to eliminate possible threats and potential support for the enemy.

In a report by Gersony (1988) regarding how civilians were treated in the Mozambique Civil War, the importance of location is shown. Attacks on civilians from the major rebel armed group RENAMO (*Resistência Nacional Moçambicana*; the Mozambican National Resistence) show different geographical patterns. Refugees reported that during the Civil War, there were three different areas: tax areas, control areas and destruction areas. In tax areas, deadly and planned violence towards civilians is rare, and the extraction of resources from local population is bearable. Tax areas are usually located in suburbs where the majority of local population are farmers (17). Control area include combatant bases, field areas that produce food, and dependent areas where seniors and children live. In the control area, the burden of extraction and taxation is much heavier than that in the tax area. Cases of indiscriminate violence towards civilians, however, are relatively lower (18-23).

Violence prevails in destruction areas. According to Gersony's interviews with refugees, there are some general characteristics. First, the previous government structures and offices were still there when the rebel group arrived with lack of effective control. This can be observed when refugees reported that RENAMO forces had to collect intelligence before they launched attacks towards the village in the destruction area (28). Second, RENAMO used selective violence on civilians in destruction areas. The rebel group used selective violence not only to eliminate the pro-FRELIMO[18] local bureaucrats, officials or secretaries but also to force political loyalty from local villagers by the demonstration of violence. This is a description of the scene of violence from a refugee:

"…a group of officials, their wives and children were burned alive in their homes after the husband had been immobilized with an ax wound, as the villagers were forced to look on. （29）"

Third, indiscriminate violence was also usually chosen by RENAMO as a tool. Victims include civilians, combatants in the government troops, pro-government militiamen, or refugees who tried to escape from destruction areas. Refugees reported that RENAMO forces had asked people to relocate to either tax areas or control areas

[18] Or *Frente de Libertação de Moçambique* (The Mozambique Liberation Front), the ruling party of Mozambique from 1975 and during the civil war.

before they perpetrated indiscriminate attacks (29-30).

Indiscriminate attacks bring higher costs for rebel groups. In Kalyvas' words, indiscriminate violence is "at best ineffective and at worst counterproductive (2004, 112)." The "unfairness" brought by indiscriminate violence is likely to instigate more resistance from local population, and would sabotage the goal of armed groups for further compliance. In the early stage of civil wars, armed group tend to use violence indiscriminately due to the lack of information on local popular support and loyalty. As war proceeds and more information is acquired when armed groups have more interactions with the local populace, armed groups would avoid using indiscriminate violence and prefer selective violence.

To conclude, the capability of control and accessibility of information in a specific area are two essential factors whether this specific area will have terrorist attacks, and what kind of terrorism. In the case of Mozambique Civil War, RENAMO launched indiscriminate violence – terrorism as defined by Kalyvas (2004) - towards local civilians in the destruction area where they lacked effective control, sufficient information and military superiority over the government/FRELIMO forces.

<u>The "routinization of violence" mechanism:</u> the third causal link arguing that civil wars may breed more terrorism is the routinization of violence. Civil wars bring daily violence in the local social structures and to people's lives. People have little choice but to accept violence in life, and they have to develop a mechanism to tolerate and accustom themselves to violence. Violence changes and sabotages the local social structures by eliminating important family members of local families, by changing people's preferences in life and expectations of interacting with people who used to be close

friends and neighbors but now become enemies. New identities are forged in war.

When violence is routinized, the threshold of violence tolerance increases among people living in local communities. Post-civil-war societies have higher homicide rates as indicated by country-level statistics (Collier and Hoeffler 2004; UNODC, 2011). A variety of violent activities are more likely to take place in post-conflict societies, including assassination and suicide bombing often seen in terrorist attacks (Geneva Declaration Secretariat 2008).

Civil wars breed other kinds of violence. One reason is that original rules, norms and conventions are broken down as war deepens it impacts in the social fabric. When social norms are “transgressed,” practices once considered unacceptable and intolerable begin to appear. War may create a new culture in the society and change people’s view on war. When the conflict spreads among people in different communities, it also creates phenomena such as the vicious cycle of revenge, hatred and violence, and the imbalance of strength between different communities. The breakdown of social norms creates an environment, in which violence is more accessible to all actors who attempt to use it as tools to achieve their goals (Greenberg Research, Inc. 1999, xii-xiv).

Kalyvas (2006) criticizes sociological and anthropological approaches such as transgression, breakdown of social norms and brutalization of violence. He argues that these approaches either fail to uncover causal relationships or render themselves unfalsifiable (70); approaches such as polarization or the emergence of new technology in warfare better explain violence towards civilians in civil wars.

The breakdown of social norms, however, would raise the threshold of death tolerance more generally. The non-state armed groups are assumed to be the major perpetrator of organized and massive violence towards civilians (except for the government). When violence towards civilians is an organized, premeditated and well-planned act that has to be done by actors with goals, the breakdown of social norms per se cannot sufficiently explain the incidence of more terrorist attacks towards civilians. However, the routinization of violence might reduce the marginal utilities of terrorist attacks taken. The normalization of violence in war-affected societies would raise the threshold of death tolerance, which means that armed groups now would have more incentives to make their terrorist tactics and strategies more severe (i.e. with more casualties) to reach the same goal that would have been attained with less death if there had not been a civil war. We can also view social norms as the environment or context, in which armed groups are influenced by incentives. If the level of death tolerance is raised, armed groups tend to launch more severe terrorist attacks to achieve their goals. And the context as an intervening variable (Goertz 1994) would create more opportunities (Most and Starr 1989) to actors within it.

3.3 GEOGRAPHIC STUDIES OF CIVIL WARS AND TERRORISM

Some researchers apply geographical methods on the studies of terrorism, and they find that terrorist attacks are spatially limited (Bahgat and Medina 2013) and are causally clustered geographically. Braithwaite and Li (2007) argue that countries tend to have more terrorist attacks if they are located in proximity to a "hot spot," or a place with higher-than-expected rate of terrorism incidence. Smith et al (2006) also report that in the US case, most terrorists reside within 50 miles of their targets. Also using terrorist cases in the US, Webb and Cutter (2010) find that terrorist incidents and perpetrators geographically overlapped. Using the Basque separatist group ETA as the case, LaFree et al (2012) report that different strategic options chosen by the terrorist group affect the distribution and diffusion attack events. LaFree and Bersani (2012) use three socioeconomic statistics—“index crime, residential stability, and language diversity”—to predict and explain the hot spots of US domestic terrorism.

However, studies on the geographic distribution of terrorism in the context of contemporary internal armed conflicts are rare. Based on the study of Kydd and Walter (2006) that terrorism is frequently used as strategies by insurgent groups in modern internal armed conflicts, Findley and Young’s research (2012) is one of the few attempts that combine terrorism, civil wars and geographical studies. They find that terrorism often appears simultaneously with civil wars. Using a small-N method with six cases, using countries of different geographic areas, economic development and political institutions, Findley and Young argue that terrorism is most likely to appear along with civil wars during the course of and after civil wars. In other cases, however, terrorism appears before war erupted. Countries with civil wars taking place in the post-Cold War era tend to have post-conflict terrorism.

By juxtaposing the “war zones” and the location and frequency of terrorism in different periods of time, Findley and Young (2012) suggest that civil wars and terrorism not only overlap in time but also in space. However, since their research is exploratory without using more geo-referenced data for essential variables such as GDP, the results of their research are indeterminate. Secondly, the traditional focus on country-level data and analyses might prevent researchers from noticing essential and locally differentiated factors, such as population. Li and Schaub (2004) find that population is positively related to the incidence rate of terrorism, and terrorism is more likely to take place in densely populated cities than in rural areas (Willis et al 2005). However, the difference in distributions of population and its local influence cannot be seen, or demonstrated, using country level data. Thirdly, the fixed concept of war zone can be a research issue. Findley and Young (2012) use the Rod and Uppsala definition of war zones to mark the area where any of the violent incidents during a civil war took place as a "war zone."[19] However, war zones, or "major battlefields," are a dynamic concept in civil war; the major battlefields in civil wars move as conflicts go through different phases. Using fixed war zones or battlefields in civil wars might exaggerate the influence of war in that area and thus generate some issues at the methodological level (Starr, Liu and Thomas 2011).

3.4 MAJOR BATTLEFIELDS IN CIVIL WARS: CONCEPT AND IMPLICATIONS

I address these issues by introducing a new concept of major battlefields along with a new geo-referenced dataset. Civil wars, as a major form of political violence, cluster in a dimension of time and space. I call these clusters of internal battle events (ICE) major battlefields (MBs). MBs are where the major and most intense conflicts take place. Locations closer to the MBs (i.e. with shorter physical distance) would be more likely influenced by the impact of war. Therefore, the terrorism accompanying civil wars and its impact should be observed in or near these major battlefields. Following the same logic, we should also observe the most-impacted social structure in local communities in or near the major battlefields.

The concept of MB not only helps us identify the potentially most-influenced areas in conflict but also indicate the level of control of major actors in a civil war. That

[19] Rod (2003) defines his war zone at the methodological level by assigning a buffer zone to the conflict event point and clipped by administrative borders, see http://www.geomatikk.ntnu.no/viewConflicts/papers/ECPR_paper.pdf

battle events cluster in a specific area not only shows the importance of the place but also indicates that it is probable that no single actor has dominant and effective control over that area. To acquire the compliance of local population, the information on political support and loyalty, or even the destruction of local support for enemies, armed group would be more likely to use terrorism in or near the major battlefields towards civilians.

There are two important indicators of MB: one is the density or intensity of ICEs (measured by the number of battle clusters in a location), and another is the duration of the battlefield status (measured by the maximum year of the cluster). These two indicators are used to demonstrate the potential impact of major battlefields. That there are more clusters in a place means more likelihood of destruction and sabotage of local social norms and structures. The higher intensity of battle clusters as well as the longer duration of clusters can also show researchers a specific area that actors are highly interested in strategically but have no complete control over, which offers more incentives for actors to engage in terrorism.

Main Hypotheses. Based on the three causal links/mechanisms between civil wars and terrorism ("terrorism as strategies," "areas of control and destruction," and "routinization of violence"), several hypotheses are derived as follows:

General likelihood:

H1: The presence of MBs at time t will increase the likelihood of terrorism at time t+n (n>=1), (That is, if the location is found in or near the MB, it would be more likely to see terrorism in the following years.)

H1-a: The intensity of MBs at time t will increase the likelihood of terrorism at time t+n (n>=1).

H1-b: The duration of MBs at time t will increase the likelihood of terrorism at time t+n (n>=1).

<u>*Severity (measured by the deaths in terrorist attacks)*</u>

H2: The presence of MBs at time t will increase the likelihood of terrorism severity at time t+n (n>=1).

H2-a: The intensity of MBs at time t will increase the likelihood of terrorism severity at time t+n (n>=1).

H2-b: The duration of MBs at time t will increase the likelihood of terrorism severity at time t+n (n>=1).

The intensity of armed conflicts is expected to increase the threshold of violence tolerance in the places used to be major battlefields. Therefore, for the perpetrators of violence, to attain their goals via the use of violence would require more killings.

<u>*Attacks on civilians*</u>

H3: The presence of MBs at time t will increase terrorist attacks towards civilians at time t+n, when n=1 or 2. But the effect will decrease when n continues to increase.

H3-a: The intensity of MBs at time t will increase terrorist attacks towards civilians at time t+n, when n=1 or 2. But the effect will decrease when n continues to increase.

H3-b: The duration of MBs at time t will increase terrorist attacks towards civilians at time t+n, when n=1 or 2.

3.5 DATA, VARIABLES AND MODELS

Measures for Dependent Variable. The dataset of terrorist attacks is obtained and modified from the Global Terrorism Database (GTD) by the National Consortium for the Study of Terrorism and Responses to Terrorism (START) at the University of Maryland (START 2013). The original data only has the names of locations where terrorist incidents took place. Therefore, to geo-reference the dataset I use several websites including the National Geo-spatial Intelligence Agency (NGA) *GeoNames Search* and Wikipedia[20]. The timespan is from 1997 to 2009 and only the Africa cases are included. There are 4,528 cases of terrorist attacks. These cases were re-assigned to 50km-by-50km fishnet grids, or cells, generated using ArcGIS 10 and Stata. The unit of analysis is the grid year.

There are three values recorded for terrorism. The first one is the accumulated number of cases in the cell ("incidence rate"). The second one records the accumulated casualty levels of terrorist attacks in the cell. To facilitate the interpretation of results and the computational process, (Stata takes a long time to estimate models if the accumulated number of attacks is used directly), the accumulated casualties of terrorist attacks within a cell are re-categorized into 6 levels for the convenience of analysis. The criteria are:

Casualties level=0 if casualty<1

Casualties level =1 if 0<casualties<=10

Casualties level =2 if 10<casualty<=100

Casualties level =3 if 100<casualty<=500

Casualties level =4 if 500<casualty<=1000

[20] For places that geographic location information extremely difficult to find, the geographic coordinates of the upper level of administrative region are assigned instead.

Casualties level =5 if casualty>1000

The value of casualties includes the number of people killed (*nkill*) and wounded (*nwounded*) in the terrorist attack. These are the two original measures in the GTD dataset. Table 3.1 shows different numbers of cases for each casualty level. Cases that have large amount of casualties are rare. There are only two cases that have more than 1,000 casualties and three cases that have 500 to 1,000 casualties. (See Table 3.1)

The third dependent variable is the nominal variable for direct attacks towards civilians in the cell. This variable is created to measure whether battle clusters offer incentives for terrorists to choose civilians as targets. There are three values: "0" indicates no attacks in the cell. "1" indicates terrorist attacks not aiming at civilians. When there is at least one attack with civilians as targets, a value of "2" is assigned. In GTD originally there are 21 target types, and I re-assign the following categories to be attacks towards civilians: business, education institution, food/water supply, private citizens and property, transportation, and utilities. These are either direct attacks towards civilians, or attacks on utilities that highly influence daily lives of civilians.

<u>Measures of Independent Variable.</u> For battle clusters, I use the Armed Conflict Location and Event Dataset (ACLED) by Raleigh and Linke (2010) for the original dataset. The timespan is also 1997 to 2009 so that the data can be used with the GTD data. There are originally 8 categories that cover events such as battles, non-combat activities, headquarters establishment, riots, attacks towards civilians, and territory transfer without violence (6-9). Only "battles" are used to form spatio-temporal clusters. These are the also defined as the internal combat events (ICE)[21].

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[21] As defined by Sambanis (2006) and other researchers, "civil wars" can only be internal armed conflicts that reach the casualties threshold of 1000 deaths per month. However, this operational definition can be

Clusters are generated using SatScan (Kulldorff 1997; 2010). Three measures of clusters used in the analysis: a dummy for major battlefield, numbers of battle event clusters, and the maximum year of cluster duration. SatScan can generate clusters in different ways based on different configurations. If a cell is included in the most likely major battlefield in a specific year, then the yearly grid is assigned "1" for the value, otherwise "0." SatScan can also estimate all possible clusters in a specific spatio-temporal dimension. When a place has multiple clusters, it shows that the events are highly concentrated and densely distributed in that area (Kulldorff 2010). In the total 126,724 cells, there are only two cells that have four clusters. As a result, the number of all possible and overlapped clusters is used as an indicator of intensity. Finally, SatScan can also estimate the duration of each cluster. The maximum year of duration for each cluster is recorded and assigned to the 50km-by-50km grid that the cluster covers. Therefore, for a cell, there are three cluster values recorded:

1) The dichotomous value whether the cell is included in a major battlefield (0 or 1)

2) The number of clusters found in the cell, and

3) The maximum temporal length of the cluster that covers the cell.

Control Variables. Other important variables to be controlled for include:

Number of armed groups: this variable measures the balance of power between armed groups in the cell. Multiple NSAGs (non-state armed groups) indicates lack of

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difficult to use when the armed conflict still continues to take place. Thus, I expand the definition here. The term "civil wars" used interchangeably with "internal armed conflicts" has a broader definition, which is closed to "non-international armed conflicts (NIACs) in the International Humanitarian Law used nowadays by INGOs such as ICRC. The definition of NIAC is "protracted armed violence between governmental authorities and organized armed groups or between such groups within a State" from the Tadic Case. For more details, please see: http://www.geneva-academy.ch/RULAC/qualification_of_armed_conflict.php.

dominant control by one armed group within the cell, and the lack of control can cause more terrorist attacks (Kalyvas 2004).

Government victory: for an NSAG, being defeated by the government in the previous year means the loss of control in that area, and the intention to avenge a loss to the government side would also increase the incentives for the armed group to use terrorist tactics.

GDP at time t-1 (logged): The gross domestic product (GDP) in the cell is the measure of economic development in the local area. The relationship between economic development and terrorism is indeterminate in some research but deemed important in others (Krueger and Maleckova 2002) as economic development is found to prompt terrorism at the country level (Llussa and Tavares 2008). Rich countries are found to be more likely targeted by terrorism, especially suicide terrorism (Krueger and Laitin 2008).

Population at time t-1 (logged): population is said to relate to higher rates of international terrorism since larger population poses a challenge for governance (Li and Schaub 2004, 241). In domestic terrorism, a larger population is expected to increase the incentives for attacks following the same logic; on the other hand, concentrated crowd also make it easier for terrorists to launch successful attacks.

Within the 100km border buffer zone: border zones in most of African countries are usually porous with multiple actors. The lack of dominant control also raises the probability of terrorist attacks. In addition, for countries with civil wars there are usually many refugee camps set up along the border, which also increases the probability for terrorist attacks.

Night lights: The level of illumination at night from NASA's satellite image is a measure for urbanization. Researchers find that terrorism tends to take place in urban areas rather than in rural areas (Willis et al 2005).

Forest cover: forests offer shelter for guerrilla fighters and is said to increase the probability of combats (Fearon and Laitin 2003). The similar environment structure may cause higher rates of terrorism. This is a dummy variable: a cell is assigned the value of one if it is covered by forest, and zero otherwise.

The existence of transitional ethnic groups: a place within a country with residing transnational ethnic groups may indicate more likelihood for the terrorism or other kinds of political violence to "spill over" to that country. Furthermore, the multiethnic environment facilitates minor-scale domestic conflicts (Ellingsen 2000). This variable should have positive effects on terrorism incidence. This is also a dummy variable: a cell is assigned the value of one if there is at least one transnational ethnic groups existing in two countries or more, and zero otherwise.

Models. Two models, zero-inflated negative binomial models (ZINB) and multinomial logit models are used in the analysis of data. For the incidence of terrorism there are 125,701 cells in the dataset having the value of zero, which accounts for 99.19% of all 126,724 cells. However, among these cells with zero, there are two groups: cells included in the major battlefields but with no incidence of terrorism, and cells not included within the major battlefields. To discover the heterogeneity of these two groups, ZINB is used to estimate the model (Long 1997, 242-243). Vuong Test results show that ZINB performs better than the negative binomial regression (Long and Freese 2006, 408)[22]. To measure the effects of major battlefields on terrorism casualties levels and attacks on civilians, I use multinomial logit models. Since there is no command in Stata for panel/time-series cross-section data, so the cluster sandwich estimator is used to allow for intragroup correlation (StataCorp 2013).

3.6 INTERPRETING RESULTS IN DIFFERENT MODELS

Effects of MBs on terrorism incidence. Nine sets of models are estimated, as shown from Table 3.2 to Table 3.10. We can see from the Model 1 series (Table 3.2) that if a place is included in the major battlefield of an internal armed conflict, the incidence rate of terrorist attacks will go up by 100% in the next year of conflict. The effect of battlefields goes on and can still be seen in the year after, as well as the second and the third year although the effect diminishes as time goes. In year t-4, the result is no longer statistically significant. The number of armed groups in the cell--which is an indicator of actors' power, dominance and control within an area--is controlled for. We can see that even after the armed group variable is taken into consideration, the effect of major battlefields on the incidence rate of terrorism still exists.

The Model 2 series (Table 3.3) tests the effect of intensity of the major battlefield on terrorism. The intensity of major battlefields is measured by the number of clusters generated by SatScan. It is a spatial measure. When there are multiple clusters are estimated in a location, there is a greater tendency that events in the spatio-temporal are easier to cluster; that is to say, there is stronger intensity of events[23]. The result shows

[22] Since the assumption for using the Poisson model for panel data (-xtpoisson-) that the variance should be equal to means--has been violated, so I use ZINB instead.

[23] Users can configure SatScan and make it estimate multiple space-time clusters for point event data. These clusters can be overlapping with each other. If a place is seen with multiple and statistically significant clusters and showing multiple spatio-temporal patterns in the location, then the distributions of data points in the place are more concentrated in space and time, i.e. more intense.

that when a battlefield is more "intense," the more likely that there would be more terrorist attacks in years t-1, t-2 and t-3. Same as the results reported in the Model 1 series, the statistically significant effect of major battlefields last for about 3 years. The influence of the duration of major battlefields is reported in the Model 5 series. It is measured by taking the year value of clusters lasting for the longest time. We can see that if the battlefield lasts longer, the likelihood of terrorism would rise: each year of increase would level up the incidence rate of 15% approximately.

The results shown in Model 1, Model 2 and Model 5 (Table 3.6) support Hypotheses H1, H1-a, and H1-b. If a place becomes a major battlefield in a civil war, it would be more likely to witness more terrorist attacks in the next several years. Other than that, as the battlefield becomes more intense or lasts longer, the probability of terrorist attacks would also go up accordingly.

Figure 3.1 shows the effect of major battlefields of internal armed conflicts on the incidence of terrorism in the North-South Kivu region along the borders shared by DRC, Rwanda and Burundi during 2000 to 2002. The blue circles are the battle events clusters found by SatScan for 2000. Almost all places with at least one terrorist event in 2001 (the red dots on the map) are included in major battlefields, as many of terrorist attacks took place in areas where the battle event clusters overlap. The overlapped areas indicate higher intensity of battle events, and the relationship between major battlefields and terrorism also matches the results from models that if a place has more estimated spatio-temporal battle clusters then it has higher probability to see more terrorist events. The effects of battle clusters in 2000 can last and still influence the incidence of terrorist events in 2002 (the cyan dots on the map).

Figure 3.2 is the comparison between battle clusters estimation and the point density measure using battle events. The green shade indicates the density of battle events in 2000. It can also be used as a measure for major battlefields of the year. However, the point density measure is less precise as its battlefield estimation is larger than that using spatio-temporal scan statistics. Furthermore, the estimation by scan statistics offers more information such as battlefield density (defined as the number of overlapped clusters in an area) and can better delineate the relationship between battle intensity/density and terrorism incidence.

Effects of MBs on Terrorism Casualties. The Model 3 series (Table 3.4) shows the different effects of MBs on casualties. Level 6 (the level with the highest casualties) is eliminated because of the scarcity of cases. Model 3-1 shows that when a place is included in the major battlefield of civil war, the likelihood of terrorism casualties at level 1, level 2 and level 3 would increase respectively by 103%, 238% and 566%. It means that being in the major battlefield has more effect on terrorist attacks with the casualties ranging from 101 to 500 people. The influence continues to exist in year t-2 with similar trends. In years t-3 and t-4, however, some of the results are no longer statistically significant.

The Model 4 series (Table 3.5) shows the influence of MB intensity on casualties. Every cluster increased in year t-1 will raise the probability of casualties from level 1 to level 3, respectively by 63.1%, 90.3% and 163%. The increase of intensity influences most on casualties of level 3. The effects continue to exist in years t-2 and t-3, demonstrating the same pattern as in year t-1 that intensified major battlefields have the highest effects on terrorist events with casualties ranging from 101 to 500 people. As for the effect of duration, each year increased in major battlefield duration contributes to different levels of casualties, and has the greatest effect on casualties level 3.

Results from these models support hypotheses H2, H2-a and H2-b. If a place is located in the "war zone" in a civil war, it is more likely to see not only more terrorist events but also terrorist attacks with higher rate of casualties. More intense battlefields as well as longer battlefields would cause more high-casualties terrorism.

Effects of MBs on Targeting Civilians. We need to distinguish direct attacks towards civilians and other types of terrorist attacks. Not all terrorist attacks are directed towards civilians, and differentiating them helps us answer other important questions.

The Model 7 series (Table 3.8) shows the effects that major battlefields have on the choice of tactics by terrorist groups or individuals. Major battlefields have greater effects on attacks directly towards civilians than non-civilian-targeting attacks in year one (t-1) and two (t-2). However, the trend begins to change in the third year and last into the fourth year that the probability of direct attacks towards civilians becomes lower than that of non-civilian attacks in the major battlefields.

The Model 8 series (Table 3.9) reports the effects of battlefield intensity on targeting civilians. The results show that as the combat intensifies, the likelihood of attacking civilians in the civil war relatively decreases instead. The effects can last up to four years after the major battlefield status. Model 9 (Table 3.10) reports that effect of duration on the choice of tactics, and it shows that prolonged major battlefields of civil wars tend to have more terrorist attacks towards civilians. Results from Models 7, 8 and 9 support hypotheses H3, H3-a and H3-b.

Discussion. Major battlefields explain the incidence of terrorist attacks in civil wars. Even after we control for the number of non-state armed groups—which is a proxy for governance and control in a place—we can still see the lingering effects of major battlefields. Our analyses show that the increased number of armed groups would raise the probability of terrorist attacks, which supports our expectation. They also suggest that places more likely to have higher rates of terrorism incidence would be those with higher GDP, with less population and transnational ethnic groups presence, and those within the 100km buffer zone around the national borders. Characteristics of major battlefields--proximity, intensity and duration—are important aspects in the explanation of terrorism in a specific area. Physical distance still plays an important role determining the effects of civil wars, as the models show that there are higher rates of terrorism incidence within than out of major battlefield areas. Places that witness more potential of clustering patterns--an indicator of intensity--have higher probability of terrorism, so are places included in longer battlefields.

The severity of terrorist attacks in the context of civil wars (which is measured by the accumulated number of deaths and wounded in the cell) is also much influenced by different aspects of major battlefields. If a place used to be a major battlefield for different armed groups and the government, then more severe terrorist attacks tend to be taken by warring parties in the internal armed conflict. The findings meet the expectation from the "routinization of violence" perspective: as the threshold of violence is raised in the context of civil wars, the marginal utility of terrorist attacks would lower. As a result, more severe attacks would be taken to achieve goals that would have been achieved using less violent tactics.

There is a noticeable finding regarding attacks on civilians. Although the casualties of terrorist attacks increase generally in the MB (and as the intensity of MBs and duration of MBs increase), attacks directly towards civilians did not increase as much as other kinds of attacks. There seems to be a trade-off relationship between the intensity of major battlefield and terrorist attacks towards civilians. However, the number of terrorist tactics increases generally as the major battlefield grows more intense. This can be a choice of tactics of non-state armed groups in the internal armed conflict: armed groups choose not to use killing civilians as much for a tactic as other kinds of tactics. This can be attributed to two reasons. First, as the war grows more intense and more militarily focused, attacking civilians directly loses its tactical value. Terrorism, as the auxiliary tactics in civil wars, makes place for more formal and military tactics when battles become more intense. Second, as Kalyvas (2006) indicates, killing civilians as a terrorist tactic is detrimental to the original purpose of securing the control over and the political loyalty from the local population. However, as more information regarding local political support is available on the change of power balance between warring parties, the number of indiscriminate violence events (i.e. direct attacks on civilians) will decrease. This logic is supported by the results from the models, which show that in the first two years after a place is included in the major battlefields of an internal armed conflict, the place is more likely to experience more terrorist attacks towards civilians. But beginning from the third year, the probability of non-civilian attacks would be higher. Results from models measuring the effects of intensity also show similar results: in major battlefields where battles are intense, there will be fewer attacks towards civilians.

The duration of major battlefields, however, tells a different kind of story. Longer major battlefields lead to more possible terrorist attacks targeting civilians. As Fearon (2004) argues, longer civil wars are caused by stalemates between warring parties and the standoff situations reflect the balance of military or general capabilities between two or more actors. When no actor has the dominant power, the option to use terrorist tactics and kill more civilians to acquire more control and political loyalty will be more likely to surface for states, armed groups or other individuals engaging in the conflict.

3.7 CONCLUSION

By establishing and applying an essential concept—the major battlefield (MB)--in this research, I find that local combat spatio-temporal clusters have great influence on local incidence, severity and target choice of terrorism. The major battlefield (MB) also provides several effective measures to estimate the effects of civil wars on terrorist events. Based on spatio-temporal scan statistics, MB not only detects and estimates most likely clusters but also provide users important information such as the temporal length and numbers of clusters in a specific area. These statistics as well as the concept itself help researchers know more about the relationship between civil wars and terrorism at the local level. By establishing different measures of major battlefields, researchers can use these measures to predict and explain the location, severity, and choice of tactics and targets of terrorism in a specific area.

The research adds to the literature of terrorism and civil war by establishing a relationship between these two similar but different forms of political violence at the micro/local level. In the literature of civil wars and terrorism, researchers put more focus on the country-level relations but much less attention is paid to the subnational-level relations is paid. My research fills this gap by providing explanations of different aspects of civil wars and terrorism. By expanding the cases using recent databases in Africa, this research produces generalizable results and verifies previous findings based on one or fewer cases. These explanations and findings are also important to geographic studies of terrorism, since most research pieces are still exploratory studies rather than explanatory research. My research indicates that major battlefields of civil wars can be an important factor for understanding terrorism at the local level. Finally, I wish that the concept and research findings on the influence of major battlefields can be effective predictors for practitioners such as international governmental organizations, peacekeepers, NGOs such as *Medicin San Frontieres* (MSF) and other organizations working hard on post-conflict recovery efforts.

In the future I plan to explore the relationship between the major battlefields and other important topics and problems in the post-conflict recovery, for example, public health issues such as the spread of epidemics, or mine problems that maim and kill many children and civilians. By locating the most intense battles in civil wars, I wish that more problems can be addressed and solved.

Table 3.1: Casualty Levels of Terrorist Events

Casualty Levels	Frequency	Percent
0	125, 859	99. 32
1	434	0. 34
2	382	0. 30
3	44	0. 03
4	3	<0.001
5	2	<0.001
Total	126, 724	100

Table 3.2: Model 1 Series

Model 1 Series: MB dummy and Terrorism incidence

	Model 1-1	Model 1-2	Model 1-3	Model 1-4
Terrorism Incidence				
MB lagged 1 year	2.003***			
	(4.67)			
Number of NSAGs	1.074	1.129**	1.162***	1.166**
	(1.68)	(2.77)	(3.38)	(3.04)
Government Victory	1.158	1.170	1.268*	1.265
	(1.76)	(1.80)	(2.27)	(1.71)
GDP t-1 logged	1.707***	1.668***	1.746***	1.714***
	(7.47)	(6.98)	(7.51)	(6.53)
Pop. t-1 logged	0.732***	0.722***	0.671***	0.679***
	(-3.87)	(-3.95)	(-4.76)	(-4.15)
100km border area	3.129***	3.264***	3.914***	3.741***
	(8.15)	(8.05)	(9.22)	(8.10)
Night light, t-1	1.004	1.003	1.006	1.005
	(0.60)	(0.45)	(0.76)	(0.67)
Forest	1.152	1.052	1.170	0.972
	(0.54)	(0.19)	(0.56)	(-0.09)
Transnational Ethni-cities	0.569***	0.531***	0.527***	0.472***
	(-4.61)	(-4.97)	(-4.87)	(-5.21)
MB lagged 2 years		1.680**		
		(3.13)		
MB lagged 3 years			1.613*	
			(2.34)	
MB lagged 4 years				1.264
				(0.85)
inflate (omitted)				
Observations	116874	107134	97394	87654

Exponentiated coefficients; t statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001
Source: Author-compiled dataset

Table 3.3: Model 2 Series

Model 2 Series: number of MBs and terrorism incidence

	Model 2-1	Model 2-2	Model 2-3	Model 2-4
Terrorism Incidence				
Num. clusters, t-1	1.584***			
	(4.89)			
Number of NSAGs	1.066	1.120**	1.162***	1.166**
	(1.50)	(2.59)	(3.38)	(3.03)
Government Victory	1.152	1.155	1.253*	1.264
	(1.73)	(1.68)	(2.17)	(1.70)
GDP t-1 logged	1.733***	1.674***	1.759***	1.718***
	(7.67)	(7.02)	(7.51)	(6.50)
Pop. t-1 logged	0.716***	0.717***	0.664***	0.677***
	(-4.14)	(-4.03)	(-4.83)	(-4.16)
100km border area	3.078***	3.274***	3.919***	3.747***
	(8.01)	(8.03)	(9.22)	(8.12)
Night light, t-1	1.005	1.004	1.006	1.005
	(0.70)	(0.50)	(0.75)	(0.67)
Forest	1.212	1.084	1.201	0.976
	(0.74)	(0.30)	(0.65)	(-0.08)
Transnational Ethn~s	0.566***	0.530***	0.525***	0.470***
	(-4.62)	(-4.97)	(-4.89)	(-5.23)
Num. clusters, t-2		1.438***		
		(3.49)		
Num. clusters, t-3			1.403**	
			(2.75)	
Num. clusters, t-4				1.202
				(1.09)
inflate				
(omitted)				
Observations	116874	107134	97394	87654

Exponentiated coefficients; t statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001
Source: Author-compiled dataset

Table 3.4: Model 3 Series

Model 3 Series: MB dummy and casualty levels

	Model 3-1	Model 3-2	Model 3-3	Model 3-4
1 (casualty level 1 = least severe; level 5 = most severe)				
MB lagged 1 year	2.035***			
	(3.35)			
MB lagged 2 years		1.972**		
		(3.28)		
MB lagged 3 years			1.892**	
			(2.94)	
MB lagged 4 years				1.365
				(1.09)
(other independent variables omitted)				
2 (casualty level 1 = least severe; level 5 = most severe)				
MB lagged 1 year	3.383***			
	(6.50)			
MB lagged 2 years		3.517***		
		(6.82)		
MB lagged 3 years			2.272***	
			(3.59)	
MB lagged 4 years				2.044*
				(2.48)
(other independent variables omitted)				
3 (casualty level 1 = least severe; level 5 = most severe)				
MB lagged 1 year	6.664***			
	(3.80)			
MB lagged 2 years		9.019***		
		(5.00)		
MB lagged 3 years			3.094	
			(1.62)	
MB lagged 4 years				1.177
				(0.15)
(other independent variables omitted)				
5 (casualty level 1 = least severe; level 5 = most severe)				
MB lagged 1 year	6.87e-14***			
	(-21.77)			
(other independent variables omitted)				
Observations	116874	107134	97394	87654

Exponentiated coefficients; t statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001
Source: Author-compiled dataset

Table 3.5: Model 4 Series

Model 4 Series: Number of MBs on casualty levels

	Model 4-1	Model 4-2	Model 4-3	Model 4-4
1 (casualty level 1 = least severe; level 5 = most severe)				
Num. clusters, t-1	1.631***			
	(3.72)			
Num. clusters, t-2		1.688***		
		(4.17)		
Num. clusters, t-3			1.648***	
			(3.81)	
Num. clusters, t-4				1.357
				(1.58)
(other independent variables omitted)				
2 (casualty level 1 = least severe; level 5 = most severe)				
Num. clusters, t-1	1.903***			
	(6.16)			
Num. clusters, t-2		1.968***		
		(6.24)		
Num. clusters, t-3			1.660**	
			(3.13)	
Num. clusters, t-4				1.631*
				(2.33)
(other independent variables omitted)				
3 (casualty level 1 = least severe; level 5 = most severe)				
Num. clusters, t-1	2.630***			
	(3.72)			
Num. clusters, t-2		2.935***		
		(5.02)		
Num. clusters, t-3			2.111*	
			(2.05)	
Num. clusters, t-4				0.892
				(-0.18)
(other independent variables omitted)				
5 (casualty level 1 = least severe; level 5 = most severe)				
Num. clusters, t-1	2.31e-16***			
	(-25.38)			
(other independent variables omitted)				
Observations	116874	107134	97394	87654

Exponentiated coefficients; t statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001
Source: Author-compiled dataset

Table 3.6: Model 5

Model 5: Max duration on terrorism incidence

	Model 5
Dependent Variable = Terrorism Incidence	
Max Duration	1.152***
	(4.09)
Number of NSAGs	1.067
	(1.50)
Government Victory	1.178
	(1.94)
GDP t-1 logged	1.655***
	(7.09)
Pop. t-1 logged	0.749***
	(-3.61)
100km border area	3.378***
	(8.60)
Night light, t-1	1.004
	(0.51)
Forest	1.223
	(0.76)
Transnational Ethnicities	0.565***
	(-4.61)
inflate (omitted)	
Observations	116874

Exponentiated coefficients; t statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001
Source: Author-compiled dataset

Table 3.7: Model 6

Model 6: Max duration on casualty levels

Casualty level: 1 = least severe; 5 = most severe	1	2	3	5
Max Duration	1.143**	1.297***	1.461***	2.93e-14***
	(3.15)	(5.67)	(3.82)	(-13.50)
Number of NSAGs	1.555***	1.604***	1.604***	1.677**
	(11.79)	(12.31)	(4.90)	(2.59)
Government Victory	1.257**	1.113	1.240	5.98e-13***
	(2.71)	(1.00)	(1.46)	(-29.98)
GDP t-1 logged	2.601***	1.960***	1.982*	0.819
	(10.28)	(5.56)	(2.46)	(-0.48)
Pop. t-1 logged	0.704***	0.881	1.044	2.120**
	(-3.76)	(-1.16)	(0.16)	(2.64)
100km border area	1.265	1.857***	1.939	6.07e-15***
	(1.59)	(3.32)	(1.73)	(-26.94)
Night light, t-1	1.034**	1.022*	1.013	1.165***
	(3.13)	(2.42)	(0.83)	(6.60)
Forest	0.798	0.989	3.473*	1.54e-13***
	(-0.79)	(-0.05)	(2.13)	(-26.38)
Transnational Ethn~s	1.364	0.974	1.164	1.21e-14***
	(1.62)	(-0.12)	(0.36)	(-21.33)
Observations	116874			

Exponentiated coefficients; t statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001
Source: Author-compiled dataset

Table 3.8: Model 7 Series

MODEL 7 Series: MB dummy on targeting civilians

	Model 7-1	Model 7-2	Model 7-3	Model 7-4
1 = non-civilian-targeted terrorist attacks				
MB lagged 1 year	2.770***			
	(4.58)			
MB lagged 2 years		3.163***		
		(5.25)		
MB lagged 3 years			2.810***	
			(4.41)	
MB lagged 4 years				2.465**
				(3.22)
(other independent variables omitted)				
2 = civilian-targeted terrorist attacks				
MB lagged 1 year	3.199***			
	(7.60)			
MB lagged 2 years		3.244***		
		(8.12)		
MB lagged 3 years			2.202***	
			(4.71)	
MB lagged 4 years				1.701*
				(2.36)
(other independent variables omitted)				
Observations	116874	107134	97394	87654

Exponentiated coefficients; t statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001
Source: Author-compiled dataset

Table 3.9: Model 8

Model 8 Series: Number of MBs on targeting civilians

	Model 8-1	Model 8-2	Model 8-3	Model 8-4
1 = non-civilian-targeted terrorist attacks				
Num. clusters, t-1	1.875*** (4.73)			
Num. clusters, t-2		2.183*** (6.09)		
Num. clusters, t-3			1.960*** (5.31)	
Num. clusters, t-4				1.734** (3.21)
(other independent variables omitted)				
2 = civilian-targeted terrorist attacks				
Num. clusters, t-1	1.861*** (6.74)			
Num. clusters, t-2		1.941*** (7.57)		
Num. clusters, t-3			1.660*** (4.38)	
Num. clusters, t-4				1.459* (2.23)
(other independent variables omitted)				
Observations	116874	107134	97394	87654

Exponentiated coefficients; t statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001
Source: Author-compiled dataset

Table 3.10: Model 9

Model 9: Max duration on targeting civilians

	Model 9	
	1=not on civilians	2=on civlians
Max Duration	1.190***	1.293***
	(3.63)	(6.69)
Number of NSAGs	1.569***	1.556***
	(11.00)	(12.97)
Government Victory	1.262**	1.219**
	(2.62)	(2.83)
GDP t-1 logged	2.216***	2.001***
	(7.72)	(7.63)
Pop. t-1 logged	0.735**	0.890
	(-3.24)	(-1.31)
100km border area	1.135	1.694***
	(0.78)	(3.68)
Night light, t-1	1.034*	1.039***
	(2.45)	(3.86)
Forest	0.699	0.977
	(-1.25)	(-0.12)
Transnational Ethn~s	1.409*	1.047
	(2.42)	(0.25)
Observations	116874	

Exponentiated coefficients; t statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001
Source: Author-compiled dataset

Battle Clusters and Terrorist Events in DRC-Rwanda-Burundi Area, 2000-2002

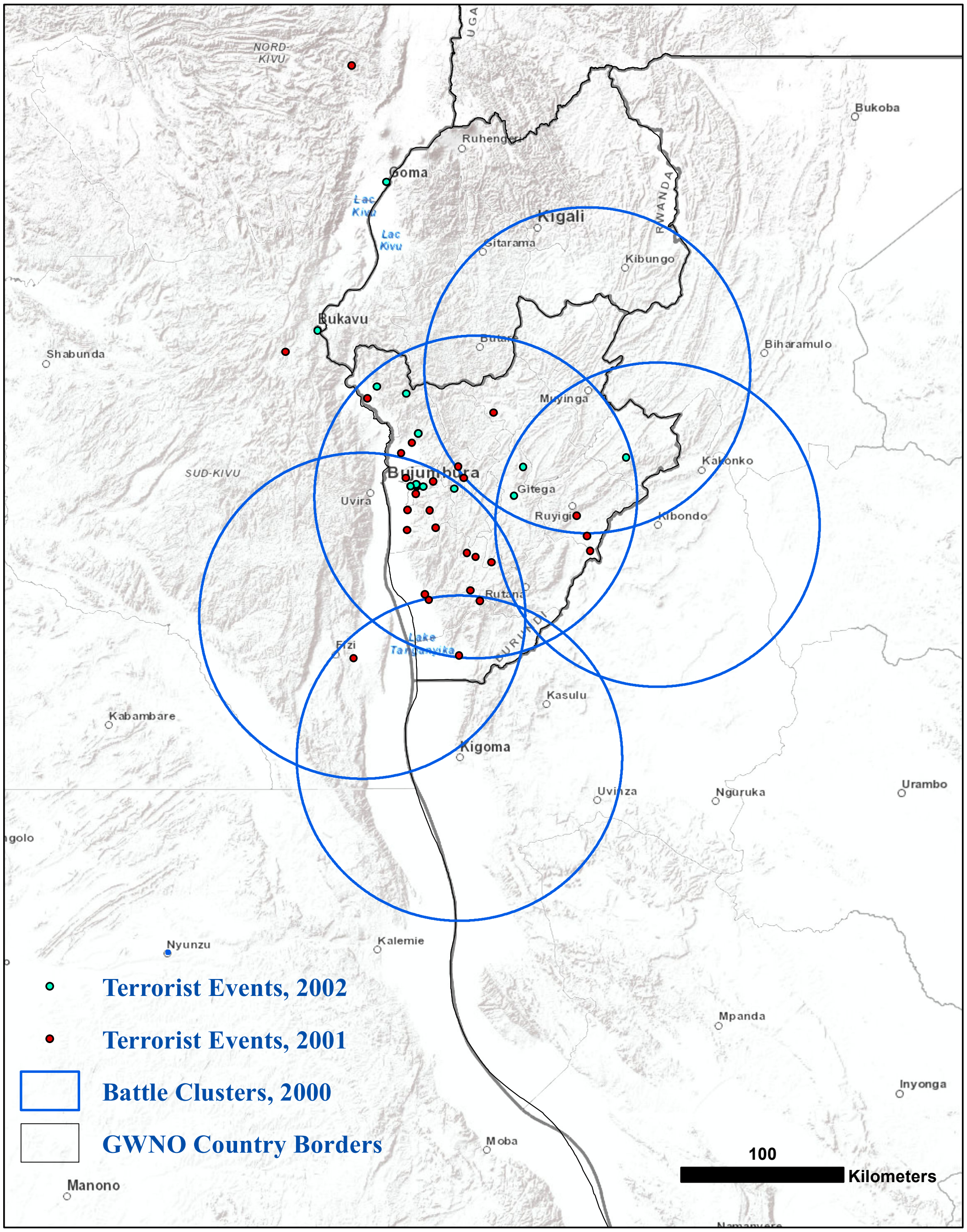

Figure 3.1: Map of Battle Clusters and Terrorist Events in DRC-Rwanda-Burundi Area, 2000-2002

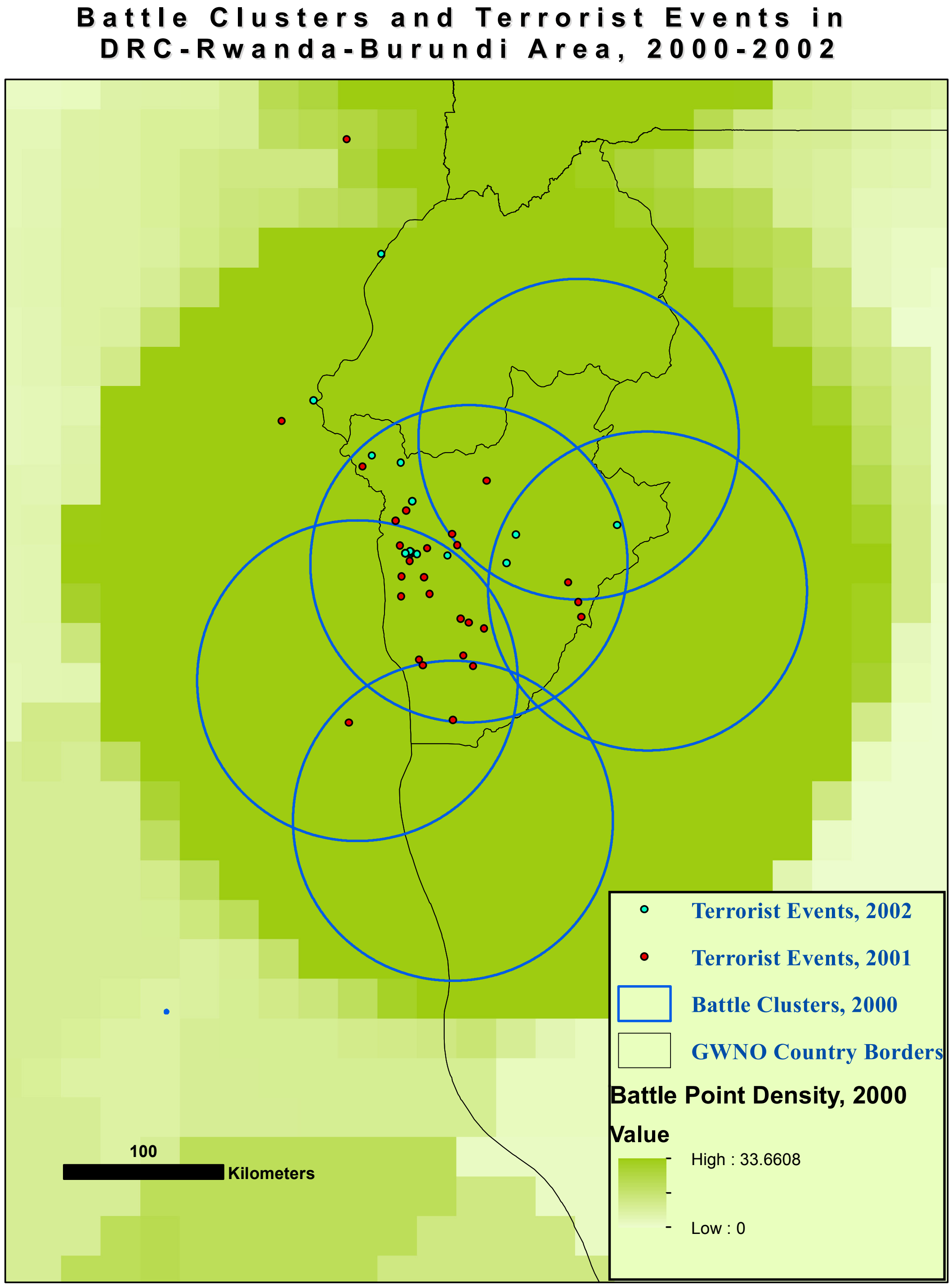

Figure 3.2: Map of Battle Clusters and Terrorist Events in DRC-Rwanda-Burundi Area, 2000-2002 (with green shade)

REFERENCES

Allison, Graham T and Philip D. Zelikow. 1999. *Essence of Decision*. New York: Addison-Wesley Educational Publishers.

Anselin, Luc. 1995. "Local Indicators of Spatial Association-LISA." *Geographical Analysis* 27(2): 93-115.

Bahgat, Karim. and Richard. M. Medina. 2013. "An Overview of Geographical Perspectives and Approaches in Terrorism Research." *Perspectives on Terrorism* 7(1): 38-72.

Beck, Nathaniel and Jonathan Katz. 1997. "The Analysis of Binary Time-Series-Cross-Section Data and/or The Democratic Peace." Paper presented at the Annual Meeting of the Political Methodology Association at Ohio State University.

Boix, Charles. 2008. "Civil Wars and Guerrilla Warfare in the Contemporary World: Toward a Joint Theory of Motivations and Opportunities." In *Order, Conflict and Violence,* eds. Stathis N. Kalyvas, I. Shapiro and T. Masoud. Cambridge, UK: Cambridge University Press.

Boulding, Kenneth E. 1962. *Conflict and Defense: A General Theory.* New York, NY: Harper Torchbooks.

Braithwaite, Alex. 2006. "The Geographic Spread of Militarized Disputes." *Journal of Peace Research 43*: 507-522.

Braithwaite, Alex and Quan Li. 2007. "Transnational Terrorism Hot Spots: Identification and Impact Evaluation." *Conflict Management and Peace Science* 24(4): 281-296.

British Broadcasting Company (BBC), 2009a. "DR Congo seeks Nkunda extradition." http://news.bbc.co.uk/2/hi/africa/784763 9.stm (Dec. 1, 2009).

British Broadcasting Company (BBC), 2009b. "Timeline: Sierra Leone." http://news.bbc.co.uk/2/hi/africa/1065898.stm (Dec. 4, 2009).

Buhaug, Halvard. 2007. "Dude, Where's My Conflict? LSG, Relative Strength, and the Location of Civil War." Presented at the 48th Annual Metting of the International Studies Association, Chicago, IL, 28 February-3 March.

--------------------. 2010. “Dude, Where’s My Conflict? LSG, Relative Strength, and the Location of Civil War.” *Conflict Management and Peace Science* 27(2): 107–128.

Buhaug, Halvard and Scott Gates, 2002. ‘The Geography of Civil War’, *Journal of Peace Research* 39(4): 417–433

Buhaug, Halvard and Päivi Lujala, 2005. “Accounting for Scale: Measuring Geography in Quantitative Studies of Civil War.” *Political Geography 24(4)*: 399-411.

Buhaug, Halvard and Jan Ketil Rød, 2006. “Local Determinants of African Civil Wars, 1970–2001.” *Political Geography* 25(3): 315–335.

Cederman, Lars-Erik, S. G. Gates and K. S. Gleditsch. 2006. “*Disaggregating Civil Wars: Project Proposal Submitted to the European Science Foundation*.” http://www.icr.ethz.ch/research/ecrp (July 1, 2009).

Cameron, A Colin and Pravin K Trivedi. 2009. *Microeconometrics Using Stata*. College Station, TX: Stata Press.

Center for International Earth Science Information Network (CIESIN), 2005. “Gridded Population of the World (GPW), Version 3. http://sedac.ciesin.columbia.edu/plue/gpw (August 10, 2011) Palisades, NY: CIESIN, Columbia University.

Clausewitz, Klaus. 1832 [1943]. *On War*. New York: The Modern Library.

Collier, Paul. 2007. *The Bottom Billion: Why the Poorest Countries Are Failing and What Can Be Done About It*. New York, NY: Oxford University Press.

Collier, Paul and Anke Hoeffler. 1998. “On the Economic Causes of Civil War.” *Oxford Economic Papers* 50(4): 563–573

-------------------------------------. 2004a. “Greed and Grievance in Civil War.” *Oxford Economic Papers* 56(4): 563-595.

-------------------------------------. 2004b. “Murder by Numbers: Socio-Economic Determinants of Homicide and Civil War.” Oxford, UK: Centre for the Study of African Economies.

Collier, Paul and Nicholas Sambanis. 2005. *Understanding Civil War: Evidence and Analysis*. Vol. 2. Washington, DC: The World Bank.

Collier, Paul et al. 2003. *Breaking the Conflict Trap: Civil War and Development Policy*. Washington, DC: The World Bank and Oxford University Press.

Collier, Paul, Anke Hoeffler and Måns Söderbom. 2004. "On the Duration of Civil War." *Journal of Peace Research* 41:253-273.

Cunningham, David E. 2006. "Veto Players and Civil War Duration." Ph.D. Dissertation Submitted to the University of California, San Diego.

David, Steven R. 1997. "Internal War: Causes and Cures." *World Politics* 49:4: 552-576.

Dorussen, Han. 2007. "Introducing PKOLED: A Peacekeeping Operations Location and Event Dataset." Paper presented at the Conference on Disaggregating the Study of Civil War and Transnational Violence, University of Essex, November 24-25, 2007.

Ellingsen, Tanja. 2000. "Colorful Community or Ethnic Witches' Brew? Multiethnicity and Domestic Conflict during and after the Cold War." *Journal of Conflict Resolution* 44(2): 228-249.

Ellis, E. C. and N. Ramankutty. 2008. "Putting People in the Map: Anthropogenic Biomes of the World." *Frontiers in Ecology and the Environment* 6(8): 439-447.

Fearon, James D. 2004. "Why Do Some Civil Wars Last So Much Longer Than Others?" *Journal of Peace Research* 41(3): 275-301.

Fearon, James D. and David Laitin. 2003. "Ethnicity, Insurgency, and Civil War." *American Political Science Review* 97:75-90.

Findley, Michael G., and Joseph K. Young. 2012. "Terrorism and Civil War: A Spatial and Temporal Approach to a Conceptual Problem." *Perspectives on Politics* 10: 2: 285–305.

Gates, Scott. 2002. "Recruitment and Allegiance: The Microfoundations of Rebellion." Journal of Conflict Resolution 46:1:111-130.

Geneva Declaration Secretariat, 2008. "Chapter Three: Armed Violence After War: Categories, Causes, and Consequences." *Global Burden of Armed Violence*. Geneva: Geneva Declaration Secretariat.

Gersony, Robert. 1988. "Summary of Mozambican Refugee Accounts of Principally Conflict-Related Experience in Mozambique." Washington DC: United States Department of State Bureau for Refugee Programs.

Ghobarah, Hazem A, Paul Huth, and Bruce Russett. 2003. "Civil Wars Kill and Maim People - Long After the Shooting Stops." *American Political Science Review 97*:2:189-202.

Gilmore, Elisabeth, Nils Petter Gleditsch, Päivi Lujala and Jan Ketil Rød, 2005. "Conflict Diamonds: A New Dataset." *Conflict Management and Peace Science* 22(3): 257-292.

Gleditsch, Nils P, P Wallensteen, M Sollenberg and H Strand. 2002. "Armed Conflict 1946-2001: A New Dataset." *Journal of Peace Research* 39:5:615-37.

Goertz, Gary. 1994. *Contexts of International Politics*. New York: Cambridge University Press.

---------------. 2000. "Cause, Correlation, and Necessary Conditions." In G. Goertz and H. Starr eds., *Necessary Conditions: Theory, Methodology and Applications.* Oxford, UK: Rowman & Littlefield.

Goertz, Gary and Harvey Starr. 2000. "Introduction: Necessary Condition Logics, Research Design, and Theory." In G. Goertz and H. Starr eds., *Necessary Conditions: Theory, Methodology and Applications.* Oxford, UK: Rowman & Littlefield.

Greenberg Research, Inc. 1999. *The People on War Report*. Geneva: ICRC.

Harff, Barbara. 2003. "No Lessons Learned from the Holocaust? Assessing Risks of Genocide and Political Mass Murder since 1955." *American Political Science Review* 97:1: 57-73.

Hoffman, Bruce. 2006. *Inside Terrorism*. New York, NY: Columbia University Press.

Holsti, Kalevi J. 1991. *Peace and War: Armed Conflicts and International Order, 1648-1989*. Cambridge, UK: Cambridge University Press.

Human Security Baseline Assessment (HSBA). 2006. "Armed groups in Sudan: The South Sudan Defence Forces in the aftermath of the Juba Declaration." *Issue Briefs* No.2. October 2006.

--. 2011. "Sudan Liberation Army-Minni Minawi (SLA-MM)." http://www.smallarmssurveysudan.org/fileadmin/docs/facts-figures/sudan/darfur/armed-groups/opposition/HSBA-Armed-Groups-SLA-MM.pdf (July 1, 2014)

Huntington, Samuel. 1962. "Guerrilla Warfare in Theory and Policy." In *Modern Guerrilla Warfare,* eds F. M. Osanka. New York, NY: The Free Press of Glencoe.

Ikelegbe, Augustine and Wafula Okumu. 2010. "Introduction: Towards Conceptualization and Understanding of the Threats of Armed Non-State Groups to Human Security and the State in Africa." In *Militias, Rebels and Islamist Militants: Human Insecurity and State Crises in Africa,* eds. Augustine Ikelegbe and Wafula Okumu. Pretoria, South Africa: Institute for Security Studies.

Jacquez, G. M. “Spatial Cluster Analysis.” In *The Handbook of Geographic Information Science*, eds John P. Wilson and A. Stewart Fotheringham. Malden, Mass: Blackwell Publishing.

Jeanty, P.W., 2010. “Splagvar: Stata module to generate spatially lagged variables, construct the Moran scatter plot, and calculate global Moran's I statistics.” http://ideas.repec.org/c/boc/bocode/s457112.html (July 19, 2014).

Johnston, Patrick. 2008. “The Geography of Insurgent Organization and its Consequences for Civil Wars: Evidence from Liberia and Sierra Leone.” *Security Studies* 17: 107-137.

Kalyvas, Stathis N. 2004. “The Paradox of Terrorism in Civil War.” *The Journal of Ethics* 8: 97-138.

----------------------. 2006. *The Logic of Violence in Civil Wars*. Cambridge, UK: Cambridge University Press.

Kalyvas, Stathis N., I. Shapiro and T. Masoud eds. 2008. *Order, Conflict and Violence*. Cambridge: Cambridge University Press.

Kennedy, F. H. 1998. *The Civil War Battlefield Guide (2nd Edition)*. Boston: Houghton and Mifflin.

Kilcullen, David. 2009. *The Accidental Guerrilla*. Oxford, UK: Oxford University Press.

Kimenyi, M. S. and N. S. Ndung'u. 2005. "Sporadic Ethnic Violence: Why Has Kenya Not Experienced a Full-Blown Civil War?" In *Understanding Civil War: Evidence and Analysis (Vol. 1)*, eds. Paul Collier and Nicholas Sambanis. Washington, DC: The World Bank.

Klingberg, Frank L. 1966. "Predicting the Termination of War: Battle Casualties and Population Losses." *Journal of Conflict Resolution* 10: 129-171.

Krueger, Alan B and David D. Laitin, 2007. “Kto Kogo: A Cross-Country Study of the Origins and Targets of Terrorism.” In *Terrorism, Economic Development, and Political Openness*, eds. Philip Keefer and Norman Loayza. New York: Cambridge University Press.

Krueger, Alan B. and Jitka Maleckova. 2002. “Education, Poverty, Political Violence and Terrorism: Is There a Causal Connection?” *NEBR Working Paper* No. 9074. Cambridge, MA: National Bureau of Economic Research.

Kulldorff, Martin. 1997. “A Spatial Scan Statistic.” *Communication in Statistics-Theory and Methods* 26(6): 1481-1496.

---------------------. 2010. “SaTScan-Software for the spatial, temporal, and space-time scan statistics.” Boston, MA: Harvard Medical School and Harvard Pilgrim Health Care.

Kulldorff, Martin, Heffernan R, Hartman J, Assunção RM, Mostashari F. 2005. “A Space-time Permutation Scan Statistic for the Early Detection of Disease Outbreaks.” *PLoS Medicine 2*: 216-224.

Kydd, Andrew H. and Barbara F. Walter. 2006. “The Strategies of Terrorism.” *International Security* 31: 1: 49-79.

Lacina, Bethany A. 2004. “Why Civil Wars Come in Different Sizes.” Presented at Workshop on Resources, Governance Structures, and Civil War. Uppsala, 13-18 April.

----------------------. 2006. “Explaining the Severity of Civil War.” *Journal of Conflict Resolution* 50(2): 276–289.

Lacina, Bethany A and N. P. Gleditsch. 2005. “Monitoring Trends in Global Combat: A New Dataset of Battle Deaths.” *European Journal of Population*(21): 145-166.

LaFree, Gary and Bianca Bersani. 2012. *Hot Spots of Terrorism and Other Crimes in the United States, 1970 to 2008. Final Report to Human Factors/Behavioral Sciences Division, Science and Technology Directorate, U.S. Department of Homeland Security.* College Park, MD: START.

LaFree, Gary, Laura Dugan, Min Xie, and Piyusha Singh 2012. "Spatial and Temporal Patterns of Terrorist Attacks by ETA." *Journal of Quantitative Criminology* 28: 7-29.

Le Billon, Philip. 2001. “The Political Ecology of War: Natural Resources and Armed Conflicts.” *Political Geography* 20: 561-584.

Lemke, D. and J. Kugler. 2006. *Parity and War.* Ann Arbor, MI: The University of Michigan Press.

Li, Quan and Drew Schaub. 2004. “Economic Globalization and Transnational Terrorism.” *Journal of Conflict Resolution* 48:2: 230-258.

Llussá, F and J Tavares. 2007. “The Economics of Terrorism: A Synopsis.” *Economics of Peace and Security Journal 2:*1:62-70.

Long, J. Scott. 1997. *Regression Models for Categorical and Limited Dependent Variables.* Thousand Oaks, CA: Sage Publications, Inc.

Long, J. Scott and Jeremy Freese. 2006. *Regression Models for Categorical Dependent Variables Using Stata.* College Station, TX: Stata Corp.

Lowi, M. R. 2005. "Algeria, 1992-2002: Anatomy of a Civil War." In Collier, P and N. Sambanis eds., *Understanding Civil War: Evidence and Analysis. Vol. 1.* Washington, DC: The World Bank.

Lujala, Päivi, Jan Ketil Rød and Nadia Thieme, 2007. "Fighting over Oil: Introducing A New Dataset." *Conflict Management and Peace Science* 24: 239-256.

Malaquias, A. 2007. "Angola: How to Lose a Guerrilla War." In *African Guerrillas: Raging Against the Machine*, eds. Boas, M and K. C. Dunn. Boulder, CO: Lynne Rienner Publishers.

Mearsheimer, John J. 2001. *The Tragedy of Great Power Politics*. New York, NY: Norton.

Melander, Erik and Magnus Öberg. 2007. "The Threat of Violence and Forced Migration: Geographical Scope Trumps Intensity of Fighting." *Civil Wars* 9: 2: 156-173.

Merari, Ariel. 1993. "Terrorism as a Strategy of Insurgency." *Terrorism and Political Violence* 5: 4: 213-251.

----------------. 2007. "Terrorism as a Strategy of Insurgency." In Gerard Chaliand and Arnaud Blin eds. *The History of Terrorism: From Antiquity to Al Qaeda.* Berkeley CA: University of California Press.

Modelski. G. 1964. "The International Relations of Internal War." In Rosenau, J. N. eds. *International Aspects of Civil Strife*. Princeton, NJ: Princeton Univ. Press.

Moore, Will H. 2005. "A Problem with Peace Science: The Dark Side of COW." Paper presented at the Peace Science Society (International), 5 November 2005, Iowa City, Iowa.

Most, Benjamin and Harvey Starr. 1989. *Inquiry, Logic and International Politics.* Columbia SC: University of South Carolina Press.

---. 2000. "Basic Logic and Research Design: Conceptualization, Case Selection, and the Form of Relationships." In G. Goertz and H. Starr eds., *Necessary Conditions: Theory, Methodology and Applications.* Oxford, UK: Rowman & Littlefield.

Mueller, John 2004. *The Remnants of War*. Ithaca, NY: Cornell University Press.

National Consortium for the Study of Terrorism and Responses to Terrorism (START). 2013. *Global Terrorism Database*. http://www.start.umd.edu/gtd (July 20, 2014)

O'Loughlin J., and C. Raleigh. 2007. "Spatial Analysis of Civil War Violence." In *Handbook of Political Geography*. 493-508. London: Sage.

O'Loughlin J. and F. Witmer. 2005. "Taking 'Geography' Seriously: Disaggregating the Study of Civil Wars." Paper presented at the conference on "Disaggregating the study of civil war and transnational violence," University of California Institute of Global Conflict and Cooperation, La Jolla, CA.

O'Sullivan, P. 1991. *Terrain and Tactics.* New York: Greenwood.

O'Sullivan, P and J Miller. 1983. *The Geography of Warfare*. New York, NY: St. Martin's Press.

Olson, Mancur. 2000. *Power and Prosperity: Outgrowing Communist and Capitalist Dictatorships.* Oxford, UK: Oxford University Press.

Openshaw, Stan. 1983. *The Modifiable Areal Unit Problem*. Norwich, UK: Geo Books.

Pape, R. 2005. *Dying to Win: The Strategic Logic of Suicide Terrorism*. New York: Random House.

Pasha, Aneeza. 2008. "Humanitarian Impact Evaluation: Battlefield Area Clearance in South Lebanon." *The Journal of ERW and Mine Action* 12:2.

Perry, E. J. 1980. *Rebels and Revolutionaries in North China, 1845-1945.* Palo Alto, CA: Stanford University Press.

Potgieter, J. 2000. "'Taking Aid from the Devil Himself'--UNITA's Support Structures." In Cilliers, J and C. Dietrich eds. *Angola's War Economy*. Pretoria, South Africa: Institute for Security Studies.

Proctor, S. et al. 2005. "Spatial Analysis of 1991 Gulf War Troop Locations in Relationship with Postwar Health Symptom Reports Using GIS Techniques." *Transactions in GIS* (9): 381-396.

Raleigh, Clionadh and Håvard Hegre, 2005. "Introducing ACLED: An Armed Conflict Location and Event Dataset." Paper presented to the conference on *Disaggregating the Study of Civil War and Transnational Violence*, University of California Institute of Global Conflict and Cooperation, San Diego, CA, 7–8 March.

Raleigh, Clionadh, Andrew Linke, Håvard Hegre and Joakim Karlsen. 2010. "Introducing ACLED-Armed Conflict Location and Event Data." *Journal of Peace Research* 47(5) 1-10.

Richards, Paul. 2001. “War and Peace in Sierra Leone.” *The Fletcher Forum of World Affairs* 25:41-50.

Richardson, Lewis F. 1960. *Statistics of Deadly Quarrels*. Pittsburgh, PA: The Boxwood Press.

Rod, Jan Ketil. 2003. “ViewConflicts: Software for Visualising Spatiotemporal Data on Armed Conflicts.” Paper prepared at the workshop on *Geography, Conflict and Cooperation*. Edinburgh, UK.

Rummel, Rudolph J. 1997. *Statistics of Democide: Genocide and Mass Murder Since 1900*. Charlottesville, VA: Center for National Security Law, School of Law, University of Virginia.

Sack, Robert D. 1986. *Human Territoriality: Its Theory and History.* Cambridge, UK: Cambridge University Press.

Sambanis, Nicholas. 2008. “Terrorism and Civil War.” In Philip Keefer and Norman Loayza eds. *Terrorism, Economic Development, and Political Openness*. New York: Cambridge University Press.

Sánchez-Cuenca, I and L De la Calle. 2009. “Domestic Terrorism: The Hidden Side of Political Violence.” *Annual Review of Political Science* 12: 31-49.

Schneckener, Ulrich. 2009. “Spolier or Governance Actors? Engaging Armed Non-State Groups in Areas of Limited Statehood.” *SFB-Governance Working Paper Series* No. 21.

Scott, Andrew M. 1964. “International Violence as an Instrument of Cold Warfare.” In *International Aspects of Civil Strife*, ed. J. N. Rosenau. Princeton, NJ: Princeton Univ. Press.

Sinno, Abdulkader H. 2008. *Organizations at War: In Afghanistan and Beyond.* Ithaca, NY: Cornell University Press.

-------------------------. 2011. “Armed Groups’ Organizational Structure and Their Strategic Options.” *International Review of the Red Cross* 93:882:1-22.

Small, Melvin and J David Singer. 1982. *Resort to Arms: International and Civil Wars, 1816-1980*. Beverly Hills, CA: Sage.

Smallman-Raynor, M and A. D. Cliff. 1999. "The spatial dynamics of epidemic diseases in war and peace: Cuba and the insurrection against Spain, 1895–98." *Transactions of the Institute of British Geographers 24*: 3: 331-352.

--. 2004. *War Epidemics: A Historical Geography of Infectious Diseases in Military Conflict and Civil Strife, 1850-2000*. UK: Oxford University Press.

Smith, BL, KR Damphousse and P Roberts. 2006. *Pre-Incident Indicators of Terrorist Incidents: The Identification of Behavioral, Geographic, and Temporal Patterns of Preparatory Conduct.* Rockville, MD: National Institute of Justice.

Smith, M. L. R. 2003. "Guerrillas in the Mist: Reassessing Strategy and Low Intensity Warfare." *Review of International Studies* (29): 19-37.

Spears, Ian. 2004. "State-Within-States: An Introduction to Their Emperical Attributes." In *States Within States: Incipient Political Entities in the Post-Cold War Era,* eds Paul Kingston and Ian Spears. London, UK: Palgrave Macmillian.

Stanton, Jessica A. 2012. "Terrorism in the Context of Civil War." *The Journal of Politics* 75(4): 1009-1022.

Starr, Harvey. 2002. "Opportunity, Willingness and Geographic Information Systems: Reconceptualizing Borders in International Relations," *Political Geography*: 21:243-261.

Starr, Harvey and G Dale Thomas. 2005. "The Nature of Borders and International Conflict: Revisiting Hypotheses on Territory." *International Studies Quarterly 49*: 123-139.

StataCorp. 2013. *Stata: Release 13. Statistical Software*. College Station, TX: StataCorp LP.

Stead, Craig F. 1997. "Oil Fires Petroleum and Gulf War Illness." *Testimony to House SubCommmittee on Human Resources and Intergovernmental Relations*, Chairman Shays C. June 26 1997.

Sutton, Paul C., S. J. Anderson, C. D. Elvidge, B. T. Tuttle, and T. Ghosh. 2009. "Paving the Planet: Impervious Surface as Proxy Measure of the Human Ecological Footprint." *Progress in Physical Geography* 33: 510-527.

Tobler, Waldo. 1970. "A Computer Movie Simulating Urban Growth in the Detroit Region." *Economic Geography* 46: 234-240.

United Nations Office on Drugs and Crime (UNODC). 2011. *Global Study on Homicide.* Vienna: United Nations Office on Drugs and Crime.

Valentino, Benjamin, Paul Huth and D. Balch-Lindsay. 2004. " 'Draining the Sea': Mass Killing and Guerrilla Warfare." *International Organization* (58): 375-407.

Varshney, Ashutosh. 2002. *Ethnic Conflict and Civic Life: Hindus and Muslims in India.* New Haven, CT: Yale University Press.

Vertzberger, Yaacov Y. I. 1990. *The World in Their Minds: Information Processing, Cognition, and Perception in Foreign Policy Decisionmaking*. Stanford CA: Stanford University Press.

Vinci, Anthony. 2007. " 'Like Worms in the Entrails of a Natural Man': A Conceptual Analysis of Warlords." *Review of African Political Economy* 34: 313-331.

------------------. 2008. "Anarchy, Failed States, and Armed Groups: Reconsidering Conventional Analysis." *International Studies Quarterly 52*: 295-314.

Ward, Michael D. and Kristian S. Gleditsch. 2008. *Spatial Regression Models*. London: Sage.

Webb, Jennifer J and Susan Cutter. 2010. "The Geography of U.S. Terrorism Incidents, 1970-2004." *Terrorism and Political Violence* 21: 3: 428-449.

Weidmann, Nils B., H. Hegre, and C. Raleigh. 2006. "Modeling Spatial and Temporal Patterns of Civil War." Paper presented at the Annual Meeting of the American Political Science Association, Philadelphia.

Weidmann, Nils B., Jan Ketil Rød and Lars-Erik Cederman. 2010. "Representing Ethnic Groups in Space: A New Dataset". *Journal of Peace Research* 47 (4): 491-499.

Weidmann, Nils B. and Monica D. Toft. 2010 "Promises and Pitfalls in the Spatial Prediction of Ethnic Violence: A Comment." *Conflict Management and Peace Science* 27: 159-176.

Weinstein, Jeremy M. 2007. Inside Rebellion: The Politics of Insurgent Violence. Cambridge, UK: Cambridge University Press.

Willis, Henry H. et al. 2005. *Estimating Terrorism Risk*. Santa Barbara, CA: RAND Center for Terrorism Risk Management Policy.

Zipf, George K. 1946. "The P1P2/D hypothesis: on the Intercity Movement of Persons." *American Sociological Review* 11: 677-686.