Terror and territory: A spatio-temporal analysis of ISIL

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TERROR AND TERRITORY: A SPATIO-TEMPORAL ANALYSIS OF ISIL

A Thesis submitted to
The Graduate College of
Marshall University
In partial fulfillment of
the requirements for the degree of
Master of Science
In
Geography
by
Robert Riley Strider
Approved by
Dr. Jamie Leonard, Committee Chairperson
Dr. Anita Walz
Dr. Kevin Law

Marshall University
May 2017
APPROVAL OF THESIS

We, the faculty supervising the work of Robert Riley Strider, affirm that the thesis, *Terror and Territory: A Spatio-Temporal Analysis of ISIL*, meets the high academic standards for original scholarship and creative work established by the Masters of Science and the College of Liberal Arts. This work also conforms to the editorial standards of our discipline and the Graduate College of Marshall University. With our signatures, we approve the manuscript for publication.

Graduate Committee Signatures

Dr. Jamie Leonard

Dr. Kevin Law

Dr. Anita Walz
ACKNOWLEDGEMENTS AND DEDICATIONS

I would like to thank Dr. Jamie Leonard, my advisor, for being extremely patient with me as I worked on this paper and giving me nudges in the right direction when needed. I would also like to thank Dr. Anita Walz for my time in her classes, learning what I would eventually use here. I would like to give my appreciations to Dr. Kevin Law and Dr. Godwin Djietror for helping me prepare for writing this thesis in the first place. Last, but not least, I would like to thank my family, Paul, Stefanie, Adam, and Mary Ann Strider for their support and patience through these years.
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ABSTRACT

The Islamic State of Iraq and the Levant (ISIL), alternatively the Islamic State of Iraq and Syria (ISIS), is one of many non-state organizations that resulted from the extensive foreign intervention in the Middle East leading up to current conflicts there. Like the wider network that it used to be part of, ISIL is considered to be a great threat to modern first world countries. Using data from the Global Terrorism Database (GTD), this paper analyzed the relationship between the amount of territory ISIL held from June 2014 to December 2015 and the attacks it carried out in that time, using Standard Deviational Ellipses to analyze directional orientation and distribution density of the attacks. The results showed that there was a slight correlation between significant land loss and increases in attacks in the following quarter.
ISIL was founded in 1999 under the name Jama’at al-Tawhid wal-Jihad (The Organization of Monotheism and Jihad) under the leadership of Jordanian Sunni radical, Abu Musab al-Zarqawi (Cheterian, 2015). Soon after, the group pledged themselves to the larger al-Qaeda terror network and took part in the fighting during the month-long Iraq War in 2003 and the 2011 Syrian Civil War, though they were only considered a serious threat in the latter conflict. Eleven years from their inception, a new leader, Abu Omar al-Baghdadi, changed the group’s name to the Islamic State of Iraq and the Levant, and later the Islamic State of Iraq and Syria, though the names tend to be used interchangeably. The leaders of al-Qaeda and various other members of the network cut ties completely with ISIL by February 2014 due to al-Baghdadi’s attempts to consolidate power under himself (Celso, 2015). During and following this dispute, ISIL carried out their Anbar Campaign, seizing control of Mosul and perpetrating the Sinjar Massacre. This offensive action sparked a renewal of US military operations in Iraq.

In June 2014, al-Baghdadi declared the beginning of a new caliphate, with himself as its Emir, and sought to turn ISIL’s territory into an actual state, which at the time consisted of holdings in northwest Iraq and northeast Syria (Celso, 2015). To be brief, ISIL’s state aspirations were rejected by world governments as well as moderate Muslims, both Sunni and Shi’ite. Since then, ISIL has been opposed by government forces of both Iraq and Syria and even other non-state militias such as the Kurds and al-Qaeda (Celso, 2015).
Based on data drawn from the Global Terrorism Database (National Consortium for the Study of Terrorism and Responses to Terrorism, 2016), ISIL carried out 2110 attacks in 12 countries between June 2014 and December 2015, including Iraq, Syria, Saudi Arabia, Turkey, Lebanon, Jordan, the Gaza Strip, Tunisia, Somalia, Egypt, Bahrain, and France (See Figure 1). However, Figure 1 only makes ISIL seem like it has a farther spatial reach than the organization actually possesses. Instead, the majority of these attacks took place in Iraq (See Figure 2).
In total, these attacks resulted in 16,801 deaths and 11,408 injured (National Consortium for the Study of Terrorism and Responses to Terrorism, 2016). While data on previous attacks by ISIL was available from the GTD, the dataset used covered the time after their official ties with al-Qaeda were severed. Figures 3 and 4 show the breakdown of the casualties by year and quarter. Despite the observed period during 2014 being shorter by five months, the number of fatalities remained close to the same as the following year. Of the seven quarters observed, Quarters 2 and 3 2014 had the highest lethality and subsequent quarters were less lethal.
During this time, ISIL has utilized a variety of methods of attack, though the most common has been bombing (National Consortium for the Study of Terrorism and Responses to Terrorism, 2016). In 2014, 501 attacks were bombings, approximately
50% of all attacks (See Figure 5). In 2015, this number increased by nearly 50% to 771 incidents (See Figure 5). The difference could be attributed to the length of the observed periods of each year, as 2014 was only observed for seven months. Interestingly, the increase in bombings appears to be inversely proportional to fatalities in 2015, save for a spike in Quarter 2 2015. The targets of these attacks have primarily been private citizens and property and military personnel (National Consortium for the Study of Terrorism and Responses to Terrorism, 2016). In 2015, attacks on private citizens increased by close to 30% and attacks against military personnel nearly doubled (See Figure 6).

Figure 5: Attack Types 2014-2015
Created by Author on October 28, 2016.
By the end of June 2014, ISIL controlled (either psychologically or physically) territory in two countries as a result of the Anbar Campaign (See Figure 7).

In Iraq, ISIL controlled or operated in most of the northern Tigris river area and a portion of the Euphrates, which included (but was not limited to) the cities of Mosul, Tall Afar, Tikrit, Abu Kamal, and Rawah, with additional small pockets to the north and to the west of Baghdad (See Figure 7). In Syria, ISIL held influence over most of the Euphrates River, which included (but is not limited to) the cities of Manbij, Bab, as-Safirah, at-Tawrah, and ar-Raqqah (See Figure 7).
Figure 7: ISIS Actual Sanctuary Map: June 2014


This information prompts a line of questioning: (1) Is there a relationship between the amount of territory ISIL controls and the spatial spread of their activities? (2) Do changes in the size of ISIL’s territory affect the total number of attacks that they can carry out on a quarterly basis?
CHAPTER II
BACKGROUND AND LITERATURE REVIEW

Studying Terrorism

The word “terrorism” is defined by the Merriam-Webster web dictionary as “the use of violent acts to frighten the people in an area as a way of trying to achieve a political goal” or “the systematic use of terror especially as a means of coercion” (Merriam-Webster, 2016). The word itself stems from the French word *terrorisme*, which referred to “state terrorism” practiced during the Jacobian “Reign of Terror” in the 1790s following the French Revolution. While terrorism is not a new tactic or subject of study, the study of terrorism did not gain prominence until the 1970s during the various conflicts in the Middle East and after the September 11, 2001 attack against the United States, which sparked the interest of academics in multiple fields and led to a surge in the publication of works on the subject (Sánchez-Cuenca, 2014). One of the issues with researching terrorism is defining what constitutes it, as there is no consensus on what defines terrorism (Roberts, 2015). Terrorism has come to be associated with guerrilla warfare carried out by non-state entities, such as al-Qaeda and ISIL, with the purpose of crippling morale by attacking civilian targets. However, operations carried out by government agencies can also be classified as terrorism, referred to as state terrorism. The infamous Nacht der langen Messer (Night of the Long Knives) is one such example that could be considered an act of state-sponsored terrorism. This paper only references non-state sponsored terrorism.

While incidents that qualify as terrorist attacks by the modern interpretation have occurred for centuries, perpetrated by individuals or small groups, there have not been
large organized non-state entities to study until the emergence of the al-Qaeda network. Different disciplines have different questions to ask and differing methods to gather answers to them. However, there is a common question: How effective is terrorism? The effectiveness of terror tactics is debatable. One argument poses that it is a rational tactic to encourage more such acts and to accomplish political goals. The opposing idea is that terror tactics are actually ineffective, as they cause the very people that the perpetrators are trying to convince to be hardened against their ideals because of their willingness to use acts such as suicide bombing. In between these two, there are scholars that say that the effectiveness of terror tactics is a case by case basis (Crenshaw 2014). The effectiveness debate is compounded due to the lack of agreement about what constitutes a terrorist attack (Sánchez-Cuenca 2014). What differentiates a terrorist bombing from a case of arson? Are attacks against civilian targets the only ones counted as terrorist attacks, or do military targets count as well (Plümper & Neumayer, 2010)?

Due to the relative scarcity of terrorism studies before the events of 9/11, a structure of study was not truly established. Early research into the subject attempted to use the same parameters used to study interstate wars, such as analyzing the connections between the warring states. However, this methodology did not apply well to the transnational nature of modern terrorist organizations (Young & Findley, 2011). Looking at the causes, the characteristics, and means of operations were similarly ineffective, so attention was turned towards how similar movements ended. Theories posited that typically, such movements either succeed at their goal, potentially becoming a legitimate political entity, or they are crushed by government action. In
reality, the latter has a high tendency to fail and backfire. What is far more likely is that the movement escalates their extremism and overreaches to the point where operation is no longer tenable and collapses from lack of support. The fact that has not happened to al-Qaeda in the 20 years of its existence led some to believe that they were unique in this regard (Crenshaw, 2014).

Research into terrorism can point out no singular cause for the phenomenon. Wealth is not a decisive reason, and only means that they can accomplish more. Al-Qaeda leader Osama bin Laden (1957-2011) was from a very wealthy Saudi Arabian family before becoming involved in the war against the Soviets in Afghanistan, and later channeled his family’s funds into the terrorist network. Other terrorists were poor and desperate, similar to the German people under the nascent Nazi regime during the late 1930s. The majority of terrorists originate from financially poor areas (Erdem & Özdemir, 2009). Still others are fanatics, desiring to enforce their views on the rest of the world. The only common factor that could be attributed to terrorism is that on some level they are all displeased with some aspect of their society, whether something has or has not changed, and feel that the status quo cannot be altered without violence (Erdem & Özdemir, 2009).

**The Islamic State of Iraq and the Levant**

Al-Qaeda, the “parent” organization of ISIL, was founded in 1988 in response to the Soviet invasion of Afghanistan, which was seen by extremists as an attack against Muslim culture. The invasion itself was one of the series of proxy wars between the Soviet Union and the United States during the Cold War. Many of the members that would make up Al-Qaeda later on were part of Operation Cyclone, an endeavor on the
part of the Central Intelligence Agency to train and fund local forces to fight against the Soviets. The primary founder of Al-Qaeda, Osama bin Ladin, was a Saudi Arabian veteran of the conflict. Unlike ISIL, Al-Qaeda is not a centralized organization, but rather spread out into cells, allowing them to have a much farther reach than ISIL as well as being more difficult to root out. The organization had been in place and active in multiple countries for years before the 9/11 terror attacks (Cheterian, 2015).

Much of the current research on ISIL is based in political science and sociology, similarly to early research on al-Qaeda, examining their ideology and origins. Established in 1999 by Jordanian radical Abu-Musab al-Zarqawi, the organization was, at its inception, one of the more extreme jihadi groups that established themselves in northern Iraq. While he announced his allegiance to al-Qaeda in October 2004, al-Zarqawi never put himself under their command, using the name to gather recruits from abroad (Cheterian, 2015. 110). Al-Zarqawi would be killed in an airstrike in 2006 and his organization, at the time named *Jama’at al-Tawhid wal-Jihad*, would fall by the wayside despite his successor’s efforts. By 2009, ISIL was “dismissed as a dysfunctional and failed organization” until the Syrian Civil War in 2013 (Celso, 2015. 21). The war provided thousands of new recruits from both Syria and abroad, swelling ISIL’s ranks. The treatment of Sunni Muslims by Shi’ite political figures in Iraq also provided a larger pool of recruitment. This rapid buildup, combined with the withdrawal of United States forces from Iraq, enabled the Anbar campaign that resulted in ISIL’s capture of the northern provinces of Iraq in early 2014 (Celso, 2015).

ISIL’s stated intentions are very different from the network they once claimed allegiance to. Unlike al-Qaeda, ISIL showed interest in conquering and holding
territories early on. They attempt to enforce sharia law in the territory they rule, something which has continued to the present. While much of the world considers ISIL a non-state militia, they see themselves as a state power. Walt (2015) compares ISIL to revolutionary forces in past civil wars, citing examples such as the Bolsheviks or the Khmer Rouge. While ISIL certainly has religious origins and goals, scholars such as Brown (2015) and Gunter (2015) show that their actions are more geared towards the sectarian conflict in Iraq and Syria. Gunter (2015) focuses on the ongoing conflict between ISIL and the Kurds of Syria, Iraq, and Turkey and the political ramifications on the region. Brown (2015) compared ISIL’s actions to that of al-Qaeda, showing that despite ISIL’s stated intentions, they are either unable or unwilling to practice the same global-scale jihad that al-Qaeda carried out. Despite carrying out attacks in France and Belgium, most of ISIL’s activities have been in Iraq and Syria.

The conflicts against al-Qaeda, ISIL, and other non-state actors in the conflicts in the Middle East have required changes to international law due to their transnational nature (Schar, 2016). Before 9/11, most international laws only applied to state powers, which prevented the unlawful invasion of sovereign territories to combat non-state actors operating within their borders. These laws can be circumvented if the state in question has been proven to provide support to the non-state entity. The war against al-Qaeda proved that such groups were willing to cross borders, requiring international law to be reinterpreted. The bombing campaigns against ISIL in 2014 were interpreted as “humanitarian interventions” by several countries to save more lives due to the Assad regime’s lack of action (Schar, 2016).
Plümper and Neumayer (2010) tested a hypothesis where they theorized that the stronger a country’s ally was militarily and economically, the more likely it was that they would be targeted by terrorist activities. They confirmed their hypothesis by concluding that the stronger the allied nation was and the higher the democracy level, the greater the risk of a terrorist attack directed against them. They also found that the risk increased for nations that were geographically closer. While the United States did not start out as allied with Iraq’s government, it can fulfill the first criteria in regards to the conflicts against al-Qaeda and ISIL. White, Porter, and Mazerolle (2013) used a similar, though expanded, methodology when they modeled terrorist activity in Indonesia, the Philippines, and Thailand, looking for patterns between 2000 and 2010, though they did not study a particular group. They used three variables as the basis of this study: risk, resilience, and volatility. They concluded that Indonesia and the Philippines showed a steady decrease in risk from the peak at the beginning of the study period, despite a sudden spike in 2008 for the latter case. Thailand, on the other hand, had more fluctuations over the study period, despite having a lower baseline risk than the other two countries. While Indonesia and the Philippines had a greater risk, Thailand had greater volatility. The latter study potentially proves the conclusion of Gao, Guo, Liao, Webb, and Cutter (2013) that proximity to a nation that has already been attacked increases the chances of attacks in neighboring countries due to the relative closeness of the three nations observed, the Philippines and Indonesia in particular. This situation bears a resemblance to the one in the Middle East. Syria, Iraq, and Iran are geographically closer together, allowing terrorist groups to cross borders relatively easily.
Contributions of Geography

Geographical Information Systems have gained prominence in the field of terrorism study, allowing for efficient visualization and analysis of trends. Many researchers use GIS programs to analyze spatial, temporal, or spatio-temporal trends, such as in the study of crime science and disease spread. Much in the same way that climate change can be predicted by documenting weather patterns, quantitative studies of terrorism watch for clusters of attacks over a set period of time, from which patterns can be found. Medina, Siebeneck, and Hepner (2011) utilized GIS to analyze spatio-temporal patterns in terrorist attacks in Iraq. Using data collected from the U.S. National Counterterrorism Center’s (NCTC) Worldwide Incidents Tracking System (WITS), they performed analyses for six month periods between 2004 and 2009. They concluded that there was a strong correlation between the number of attacks and the population count, and the number of attacks and population density, but no correlation between population or population density and attack intensity. The similarities between crime analysis and terrorism study are close enough that the same methods can be applied to both. Gao et al. (2013) utilized spatial auto-correlation, space-time clustering analyses, and hot spot detection to identify and analyze clusters. The coordinates of each terror incident were geocoded and analyzed by a space-time prospective analysis program called SaTScan to detect clusters and enable the researchers to focus on clusters with a high rate of terrorist activity. The researchers created “life trajectories” out of these clusters to display potential future patterns of growth for analysis. The results showed several patterns, one of which was a contagion effect based on proximity. The closer a country was to one that suffered an attack, the more likely it was to be attacked as well.
The mean is simply a single number that indicates a center in the data. With a map, the spatial mean is indicated by the mean x and y coordinates taken from the data and applied to a two-dimensional image. Standard Deviation is the measure of how many degrees of magnitude away from the center a given number in the data is. The first standard deviation away from the mean contains approximately 68.2% of all the scores, followed by 95.4% and 99.6% for the next two. In geography, the standard deviation circle is the same principle applied to a two-dimensional image to measure the spread of data. However, a standard deviation circle is only effective when the data is normally distributed. When the data is not normally distributed, a variant of the standard deviational circle is used: the Standard Deviational Ellipse (SDE). Coined by D. Welty Lefever in 1926 (Lefever, 1926), this measure of dispersion utilizes only the mean and standard deviation in its equations to first determine a center point, or mean center, upon which the ellipse would rotate, followed by calculating the curve to find the ellipse. The shape of the ellipse, according to Lefever, was “a function of the calculated standard deviation and the angle $\Theta$ between the two axes” (Lefever, 1926. 90). The orientation of the resulting ellipse was based off a line of best fit and concentration was measured by the ratio of points within the ellipse. The SDE has become an extremely versatile tool in GIS due to its ability to overcome issues associated with anisotrophic terrain by being able to detect potential relationships with a physical feature (Wang, B., 2015). While standard deviational ellipses can be used on their own for analysis, they often serve as the base for higher level analyses (Wang, Shi, and Miao, 2015), such as determining directional orientation or distribution density of geographical units (Gong, 2002).
The Standard Deviational Ellipse is based on three factors: the angle of rotation along the Cartesian coordinate system, the deviation along the major axis (x-axis), and the deviation along the minor axis (y-axis) (Wong and Lee, 2005). As such, it has not changed since Lefever coined the term, save for the calculations becoming more precise. Unlike the Standard Deviation Circle, the SDE can compensate for deviations in direction, indicated visually by the orientation of the ends of the major axis of the ellipse. Often, the distribution of points will also show linear patterns coinciding with geographical features or man-made structures, such as rivers or roads. The ellipse will become more circular if the data is closer to being normally distributed, and it becomes more elliptical if it is not normally distributed. Otherwise, an SDE operates on the same principles as a Standard Deviation Circle.

Kent and Leitner would compare and contrast the use of standard deviation circles and standard deviational ellipses in the study of crime science (Kent and Leitner, 2007). The standard deviation circle relied on a regularly distributed dispersion of points to provide an accurate assessment, but could not account for irregularly distributed data as the standard deviational ellipse could. In addition, the standard deviational ellipse was able to display directional data to more accurately analyze the patterns of commuting type crimes. Although published earlier, Levine would incorporate SDEs into the analytical methodology of his program, CrimeStat (Levine, 2006). CrimeStat operates by feeding crime data, namely locations and times of incidents, to produce visual and statistical data, one of the noted examples being standard deviational ellipses. Automated programs such as Crimestat are becoming necessary due to the sheer amount of data that needs to be processed on modern systems.
Other than crime analysis, standard deviational ellipses have seen prominence in tracking the spread of disease and immigration. Saxena et al. (2012) used various statistical methods to track the spread of malaria in India between 2007 and 2009. A weighted SDE was one of the methods used to display data from other analyses to note any changing trends and spatial shifting between the years of observation. Similar processes have been utilized by other malaria studies, such as Eryando, Susanna, Pratwi, and Nugraha (2012) during their observation in Indonesia, though they added in environmental factors such as rainfall and temperature. Tenzin, Dhand, Timsina, and Ward (2010) mapped out occurrences of rabies using SDEs to track the 2008 re-emergence of rabies in Bhutan, concluding that the rapid spread was due to the contribution of stray dogs. Cui and Piracha (2012) utilized SDEs to show the distribution of both segregation and congregation of ethnicities in Sydney, Australia. They concluded that different ethnic groups of foreign born residents congregated to certain parts of Sydney due to factors such as socio-economic conditions and the size of the communities.

This project will utilize Standard Deviational Ellipses, calculated and created with the Arcmap 10 software, to spatially analyze terror activities for a nineteen-month period. Data for the analysis was retrieved from the Global Terrorism Database created by the University of Maryland, starting in June 2014 and ending in December 2015. ArcMap 10 will also be used to geocode the data to enable the creation of spatial means and Standard Deviational Ellipses for each quarter observed.
CHAPTER III
DATA AND ANALYSIS

Source Data

The dataset used for this project was pulled from the Global Terrorism Database (GTD) and contains 2,008 data points. The Global Terrorism Database is a database maintained by the University of Maryland. Data is collected from open-source media by the faculty of the University of Maryland, though it is not added to the database until it has been confirmed to be credible. Inherited from the Pinkerton Global Intelligence Service in 2001, the database contains data on terrorist attacks from 1970 to 2015, a total of approximately 150,000 attacks with over 45 variables. The database is noted as the “most comprehensive unclassified database on terrorist events in the world” (National Consortium for the Study of Terrorism and Responses to Terrorism, 2016).

The parameters used to select the data were that the incidents occurred after June 2014 and that the perpetrator group was ISIL. The data was intended to coincide with ISIL’s declaration of independence from al-Qaeda. The data consists of the name of the city and country of occurrence, casualties, weapon type, target type, and date (See Table 1). No incidents following December 2015 have been added to the GTD as of the writing of this paper (May 2017). The data retrieved was only for attacks confirmed to have been carried out by ISIS and its affiliate organizations, excluding merely “ISIS-inspired” attacks.
<table>
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<th>Fatalities</th>
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<td>Quarter 2 2014 (June)</td>
<td>119</td>
<td>2959</td>
<td>695</td>
</tr>
<tr>
<td>Quarter 3 2014 (July-September)</td>
<td>423</td>
<td>3232</td>
<td>1890</td>
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<tr>
<td>Quarter 4 2014 (October-December)</td>
<td>338</td>
<td>2173</td>
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<td>Quarter 1 2015 (January-March)</td>
<td>288</td>
<td>1712</td>
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<td>Quarter 2 2015 (April-June)</td>
<td>338</td>
<td>2866</td>
<td>1846</td>
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<tr>
<td>Quarter 3 2015 (July-September)</td>
<td>322</td>
<td>2086</td>
<td>2171</td>
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<tr>
<td>Quarter 4 2015 (October-December)</td>
<td>280</td>
<td>1773</td>
<td>2128</td>
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Table 1: Summarization of numerical data retrieved from the Global Terrorism Database

Pre-processing

Before analysis could begin, one issue needed to be resolved. The dataset from
the GTD was not geocoded and so had to have latitude and longitude values added
manually. The latitude and longitude values were entered into an Excel spreadsheet
and were used to create a cities shapefile in ArcMap 10, upon which spatial analysis
could be based. Due to the need to examine the data over time, the dataset was split up
into different groups based on the date of the incident. This resulted in seven new
datasets, each representing three month periods. The exception was the first group,
representing only June 2014, which was used as a baseline to compare with
subsequent quarters. Following this, the spreadsheets containing the data from the
GTD were entered into spatial joins with the “cities” shapefile based on the city name to
create the basis of analysis.

The maps used for the later analysis use two different projections due to the
spread of ISIL’s activities from the Middle East. Maps centered on the Middle East are
projected using the UTM WGS 1984 38N (See Figures 8, 10, 12, 14, 16, 18, 21, 22, and 23). The maps showing more of the world are projected with the Robinson World projection (See Figures 1 and 20).

**Spatial Data**

Changes in spatial patterns over time were analyzed with the creation of seven maps, one for each quarter of the year between June 2014 and December 2015. As ISIL’s attacks began to occur in more countries, the area of observation increased as well. The attacked cities were displayed with graduated symbols with the larger symbols representing more attacks in the city indicated.

A spatial mean was created for each map in ArcMap 10, weighted by the number of attacks per city, resulting in it being placed within one standard deviation of approximately 68% of all points on the map, though this number varied from map to map. From there, a weighted Standard Deviational Ellipse was applied to each map to highlight spatial shifts in both the clustering of attacks and the spatial mean, utilizing the same parameters. Based on the number of cities and their distribution, the ellipse would either shrink or grow. The spatial mean and the Standard Deviational Ellipse are used to express the statistical mean and standard deviation in a visual format for data that is not normally distributed by averaging the geographical positions of each point against the spatial mean, using weighting factors to determine importance based on the number of attacks per city. The ellipse can also indicate physical features of the landscape based on the orientation. For example, the ellipse for Quarter 2 2014 is northwest to southeast oriented and nearly matches the direction of the Tigris River, around which most of the attacks for that quarter have taken place.
The Standard Deviational Ellipse also shows the distribution of points by the shape of the ellipse. The closer to being normally distributed the data is, the more circular the ellipse becomes. If the points are not normally distributed, the ellipse narrows and lengthens to accommodate the furthest point. In Quarter 4 2015, the Paris attacks, an extreme outlier, cause the ellipse for that quarter to stretch well beyond the area the other ellipses cover. Excluding the extreme outlier causes the resulting ellipse to show the data as being closer to normally distributed.

**Spatial Analysis and Results**

The Institute for the Study of War (ISW) is an American think tank founded in 2007 by Dr. Kimberly Kagen as an open source, non-partisan, and non-profit research organization (Institute for the Study of War, 2007). One of the on-going projects is a series of maps created by members of the ISW using non-classified and fully documented information, as well as staff in the field, showing the progression of ISIL’s territory gains and losses.

On these maps, the colors represent different aspects of analysis. Black represents territory that ISIL controlled either physically or psychologically. Red represents territory known to be frequently attacked, but is not controlled by ISIL. Brown represents regions where ISIL support can be found, but the territory is not controlled by ISIL. Green represents land controlled by the Kurds. The blue ellipses present on several of the maps are not Standard Deviational Ellipses, but indicators of changes to any of the above categories.
Beginning in June 2014, ISIL controlled (either psychologically or physically) territory in two countries (See Figure 7) as a result of the Anbar Campaign (Celso, 2015). In Iraq, they controlled most of the northern Tigris river area and a portion of the Euphrates, which included (but is not limited to) the cities of Mosul, Tall Afar, Tikrit, Abu Kamal, and Rawah, with additional small pockets to the north and to the west of Baghdad. In Syria, they held influence over most of the Euphrates River, which included (but is not limited to) the cities of Manbij, Bab, as-Safirah, at-Tawrah, and ar-Raqqah.

By the end of Quarter 2 2014, ISIL carried out a total of 119 attacks that resulted in 2959 deaths and 695 injured (National Consortium for the Study of Terrorism and Responses to Terrorism, 2016). The majority of these attacks took place in Iraq between Mosul and Baghdad, which are displayed with graduated symbols (See Figure 8). The mean center of the attacks was determined to be just west of Tikrit, Iraq, in between the two largest concentrations of attacks: Mosul and Aythah (See Figure 8). The standard deviational ellipse covers approximately 350 miles on the x-axis and 250 miles on the y-axis. Of the 41 cities attacked during this time, 28 (70%) were within one standard deviational ellipse of the mean center (See Figure 8). The ellipse had a directional orientation of northwest to southeast at approximately 80 degrees clockwise, to encompass Mosul and Aythah. Due to Quarter 2 2014 encompassing a single month instead of three, it was only used as a baseline and comparisons of activity between 2014 and 2015 excluded it as an outlier.
Figure 8: Islamic State of Iraq and the Levant Quarter 2 2014 Attacks
Created by Author on October 31, 2016.
By September 2014, ISIL had lost control of the road south of Tuz Khurmatu, Iraq (See Figure 9). Otherwise, they had not gained or lost significant amounts of territory. The section of northern Iraq denoted by light green represents areas inhabited by the Kurds, whose armed forces are considered another non-state militia, though one in opposition of ISIL.

During Quarter 3 2014, ISIL carried out 423 attacks, causing 3232 deaths and 1890 injured (National Consortium for the Study of Terrorism and Responses to Terrorism, 2016). As before, these attacks primarily took place in Iraq, close to the center of their control. The standard deviational ellipse covers approximately 500 miles
on the x-axis and 300 miles on the y-axis. Of the 94 cities attacked, 63 (67%) were within one standard deviational ellipse of the mean center, determined to be just west of Tikrit. While the mean center was only shifted a few miles southwest, the ellipse was west to east oriented at approximately 20 degrees clockwise due to several attacks in Turkey and Egypt (See Figure 10).
Figure 10: Islamic State of Iraq and the Levant Quarter 3 2014 Attacks

Created by Author on October 31, 2016.
In winter 2014, ISIL’s control territory grew to include Aleppo and the northern Syrian border, as well as Hit, Iraq (See Figure 11). ISIL lost control of Baiji, but continued attacks in the area.
Figure 12: Islamic State of Iraq and the Levant Quarter 4 2014 Attacks
Created by Author on October 31, 2016.
Over the course of 338 attacks in Quarter 4 2014, there were 2173 deaths and 1377 injured (National Consortium for the Study of Terrorism and Responses to Terrorism, 2016). The standard deviational ellipse covered approximately 350 miles on the x-axis and 150 miles on the y-axis. Of the 75 cities attacked, 50 (67%) were within one standard deviational ellipse of the mean center. The mean center shifted approximately fifty miles southwest of Tikrit, Iraq. The resulting ellipse was northwest to southwest oriented at approximately 45 degrees clockwise (See Figure 12), due to a lack of activity in Egypt and an increase in activity on the Syria-Turkey border, specifically in Kobani, Syria.

Figure 13: ISIS Sanctuary Map: March 4, 2015
Between January and March 2015, ISIL gained territory on the Syria-Lebanon border, though they also lost approximately one-third of their control of the Turkey-Syria border (See Figure 13).

During Quarter 1 2015, ISIL carried out 288 attacks, causing 1712 deaths and 1846 injured (National Consortium for the Study of Terrorism and Responses to Terrorism, 2016). The standard deviational ellipse covered approximately 400 miles on the x-axis and 300 miles on the y-axis. The mean center of the SDE rests approximately 100 miles southwest of Tikrit, a difference of 50 miles from Quarter 4 2014. Of the 86 cities attacked, 53 (61%) were within one standard deviational ellipse of the mean center. The resulting ellipse is northwest to southeast oriented at approximately 45 degrees clockwise (See Figure 14).
Figure 14: Islamic State of Iraq and the Levant Quarter 1 2015 Attacks
Created by Author on October 31, 2016.
One year after their declaration, ISIL lost control of most of the north Syrian border remaining after Quarter 1 2015 (See Figure 15). They also made the largest gain in territory during this time by seizing a significant amount of territory between Damascus and Deir ez Zeur in Syria as well as south of Damascus.

Over 338 attacks in Quarter 2 2015, ISIL caused 2866 deaths and 1846 injured (National Consortium for the Study of Terrorism and Responses to Terrorism, 2016). The standard deviational ellipse covered approximately 500 miles on the x-axis and 250 miles on the y-axis. The mean center is approximately 75 miles west of Tikrit. Of the 90
cities attacked, only 48 (53%) were within one standard deviational ellipse from the mean center. The SDE is northwest to southeast oriented at approximately 45 degrees clockwise (See Figure 16).

![Map of Islamic State of Iraq and the Levant Quarter 2 2015 Attacks](image)

**Number of Attacks Per City**
- 1 - 8
- 9 - 16
- 17 - 24
- 25 - 32
- 33 - 41

**Mean Center**
**Standard Deviational Ellipse**

*Figure 16: Islamic State of Iraq and the Levant Quarter 2 2015 Attacks*
*Created by Author on October 31, 2016.*
By September 2015, ISIL seized the road between ar-Rutbah, Iraq, and the Iraq-Syria border (See Figure 17). They also secured and expanded their hold on the road between Mosul and Hawija.

ISIL carried out 323 attacks in Quarter 3 2015, in which 2086 people were killed and 2171 were injured (National Consortium for the Study of Terrorism and Responses to Terrorism, 2016). The standard deviational ellipse covered approximately 450 miles on the x-axis and 250 miles on the y-axis. The mean center was 100 miles west of Tikrit. Of the 77 cities attacked, 47 (61%) were within one standard deviational ellipse of Tikrit.
the mean center. The ellipse was northwest to southwest oriented at 45 degrees clockwise (See Figure 18).
Figure 18: Islamic State of Iraq and the Levant Quarter 3 2015 Attacks
Created by Author on October 31, 2016.
By December 2015, ISIL lost control of Sinjar and the surrounding region while making no significant gains (See Figure 19). During Quarter 4 2015, ISIL performed 280 attacks, killing 1773 people and injuring 2128 (National Consortium for the Study of Terrorism and Responses to Terrorism, 2016). For the first time, ISIL struck outside of the Middle East with attacks in France and Tunisia. The resulting standard deviational ellipse covered 1350 miles on the x-axis and 225 miles on the y-axis. The mean center was 170 miles west of Tikrit. Of the 74 cities attacked, 53 (71%) were within one standard deviational ellipse of the mean center. The standard deviational ellipse was...
northwest to southeast oriented at 30 degrees clockwise (See Figure 20). The extreme difference between the Quarter 3 2015 SDE and the Quarter 4 2015 SDE can be attributed to the presence of several extreme outliers: the Paris and Tunis City attacks. Excluding the extreme outliers resulted in a more normally-shaped ellipse that covered 500 miles on the x-axis and 250 miles on the y-axis. The mean center was estimated to be 50 miles southwest of Tikrit. The ellipse contained only 39 (54%) of the 72 cities attacked during that quarter (See Figure 21).
Figure 20: Islamic State of Iraq and the Levant Quarter 4 2015 Attacks
Created by Author on October 31, 2016.
Figure 21: Islamic State of Iraq and the Levant Quarter 4 2015 Attacks Excluding Extreme Outliers
Created by Author on November 30, 2016.
Overall, the mean center of attacks from 2014 to 2015 has shifted approximately 125 miles west (See Figure 22). However, the exclusion of the extreme outliers in France and Tunisia caused the mean center of Quarter 4 2015 to shift southeast of its original position, resulting in a net shift of 35 miles southwest from 2014 to 2015 (See Figure 23). The Standard Deviational Ellipses shifted from north to south oriented to west to east oriented. The Quarter 2 2014 ellipse (See Figure 8) matched the Tigris River due to most of ISIL's attacks during that period occurring in cities on the banks of the river. The ellipses of subsequent quarters were oriented to match the Euphrates River due to both an increase in activity in cities along the river and countries to the south and west of Iraq and Syria.
Figure 22: Standard Deviational Ellipses and Mean Centers 2014-2015
Created by Author on November 28, 2016.
Figure 23: Standard Deviational Ellipses and Mean Centers 2014-2015 With Exclusion of Outliers
Created by Author on December 5, 2016.
Figure 6: June 2014
Figure 7: September 2014
Figure 8: December 2014
Figure 9: March 2015
Figure 10: June 2015
Figure 11: September 2015
Figure 13: December 2015

Figure 24: ISIL Territory Change Overview
Compiled by Author on April 26, 2017.
Looking at the overviews of both the territory changes (See Figure 24) and the attacks carried out by ISIL (See Figure 25) shows that, though ISIL gradually shifted its power base into Syria, the majority of their activities continued to take place in Iraq.
CHAPTER IV
CONCLUSION AND DISCUSSION

The largest land gain (See Figure 13) and second highest number of attacks
(National Consortium for the Study of Terrorism and Responses to Terrorism, 2016)
were during Quarter 2 2015 when ISIL seized territory to the northeast and southeast of
Damascus, Syria. The territorial losses of the previous quarter, which included a
significant amount of the Syria-Turkey border and was the largest loss of the seven
quarters (See Figure 11), seem to correlate with the increase in attacks that occurred
during Quarter 2 2015 (National Consortium for the Study of Terrorism and Responses
to Terrorism, 2016). However, Quarter 3 2014, which saw little to no territorial gains
(See Figure 9), had the highest number of attacks and the most damage caused
(National Consortium for the Study of Terrorism and Responses to Terrorism, 2016).
The increase could be attributed to fervor generated by al-Baghdadi’s announcement in
June 2014, with the intent of the attacks being on causing damage rather than seizing
land.

The mean center for each map shifted west as more attacks occurred outside of
Iraq and Syria, though due to the concentration of attacks on cities near the Tigris River,
it did not move very far (See Figure 25). The points were relatively normally distributed,
though the Standard Deviational ellipses grew on the x-axis and y-axis to accommodate
more points. The exception to this is Quarter 4 2015 (See Figure 20), where ISIL made
its first attacks outside of the Middle East.

With the exclusion of Quarter 2 2014 and the extreme outliers from Quarter 4
2015, the majority of the data show very little geographical changes (See Figure 23).
Despite increasing numbers of attacks by ISIL-inspired perpetrators, the majority of ISIL attacks remain in Iraq and Syria (See Figure 24 and 25). While the directional orientation of the Standard Deviational Ellipses may change, the sizes of the SDEs remain close (See Table 2).

<table>
<thead>
<tr>
<th>Quarter</th>
<th>X-Axis (In Miles)</th>
<th>Y-Axis (In Miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quarter 2 2014</td>
<td>350</td>
<td>250</td>
</tr>
<tr>
<td>Quarter 3 2014</td>
<td>500</td>
<td>300</td>
</tr>
<tr>
<td>Quarter 4 2014</td>
<td>350</td>
<td>150</td>
</tr>
<tr>
<td>Quarter 1 2015</td>
<td>400</td>
<td>300</td>
</tr>
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<tr>
<td>Quarter 3 2015</td>
<td>450</td>
<td>250</td>
</tr>
<tr>
<td>Quarter 4 2015*</td>
<td>500</td>
<td>250</td>
</tr>
</tbody>
</table>

Asterisk Indicates Exclusion of Outliers

Table 2: Approximate Dimensions of SDEs per Quarter (In Miles)

While the data from the Global Terrorism Database ends at December 2015 as of the writing of this paper (National Consortium for the Study of Terrorism and Responses to Terrorism, 2016), ISIL has continued to spread its influence. Media sources report more attacks outside of the Middle East, such as the attack in Brussels, Belgium on March 22, 2016. There have also been reports of attacks in east Asia, such as Indonesia and the Phillipines (Lister et al., 2016). While many of the attacks reported are actually committed by ISIL, attacks committed by “ISIS-inspired” terrorists are reported with them. ISIL’s controlled territory has almost completely shifted into Syria.
Despite ISIL’s now seemingly longer reach, their territory inside of the Middle East has been reduced significantly since December 2015 (See Figure 13). As of December 2016 (See Figure 26), the only pieces of territory ISIL controls inside of Iraq are Mosul, Hawaji, and Qaim, with their power base having almost completely shifted into Syria. These pieces of information suggest a correlation between loss of territory and potential range of operation. A concern has come up over the current fighting over Mosul: If Mosul is lost, will surviving ISIL operatives begin striking out at Europe (Meyer & Nichols, 2016) as foreign fighters return home? This concern is also applicable to the
territories in Syria, as once their centralized power is gone where will the fighters go? Based on the data used for this paper and subsequent developments in 2016, ISIL is not quite the global threat that many fear it to be. While certainly dangerous, their activities have been limited in scope and decreasingly effective, at least in regards to their stated goal.
Appendix A: Office of Research Integrity Approval Letter

Office of Research Integrity

April 10, 2017

Robert Strider
401 10th Street, Suite 906
Huntington, WV 25701

Dear Mr. Strider:

This letter is in response to the submitted thesis abstract entitled “Terror and Territory: A Spatio-Temporal Analysis of ISIL.” After assessing the abstract it has been deemed not to be human subject research and therefore exempt from oversight of the Marshall University Institutional Review Board (IRB). The Code of Federal Regulations (45CFR46) has set forth the criteria utilized in making this determination. Since the information in this study does not involve human subjects as defined in the above referenced instruction it is not considered human subject research. If there are any changes to the abstract you provided then you would need to resubmit that information to the Office of Research Integrity for review and a determination.

I appreciate your willingness to submit the abstract for determination. Please feel free to contact the Office of Research Integrity if you have any questions regarding future protocols that may require IRB review.

Sincerely,

Bruce F. Day, ThD, CIP
Director

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doi:10.1080/00330124.2012.724348


micro level for priority control in Ranchi district, Jharkhand. *Indian Journal Of Medical Research, 136*(5), 776-782.


**Dataset:**


**Software:**