USING DIGITAL AND HISTORICAL GAZETTEERS TO GEOCODE FRENCH AIRBORNE OPERATIONS DURING THE FRENCH INDOCHINA WAR

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by

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1.1 The Street Without Joy

On June 18, 2010, retired General Marcel Bigeard died at the age of 94. A highly decorated soldier, General Bigeard had the distinction of entering the French military at the lowest enlisted rank and rising to the level of a senior general in the French Army (French Army 2010). Born a week before the start of the Battle of Verdun, General Bigeard spent his lifetime fighting for France. In his eulogy, he was praised for his love of country, but it was not France where General Bigeard wished to have his ashes scattered. That honor was reserved for a place in Vietnam: Dien Bien Phu (BBC Press, 2010). Those wishes were unfulfilled and his remains lay in state at Les Invalides in Paris, a little less than nine thousand kilometers from Dien Bien Phu, because the government of Vietnam denied his last request citing fears that it would set a precedent amongst other foreign soldiers.

General Bigeard was a French paratrooper who fought in the two pre-eminent battles of French decolonization: the Battle of Dien Bien Phu and the Battle of Algiers.
General Bigeard also was an individual who transcended the period, and aided in synthesizing personal military experiences into theories of counterinsurgency warfare. Given its history during the Twentieth Century and the continuing conflicts of today, Southeast Asia is an important study area for examining the involvement by western militaries in the affairs of developing countries. The French Indochina War was one of the first wars of decolonization following World War II; yet there has been little investigation of the spatial pattern of one of the more important aspects of combat operations in that war – the role of airborne troops.

The French Indochina War has been given many nicknames but perhaps one of the most insightful was “the war of the vast empty spaces” which was memorialized in Bernard Fall’s (1961) book *The Street Without Joy*. Another historian, Douglas Porch also characterized the War as the “Paratrooper’s War” (Porch, 1991). However, there are very works in English that discuss this aspect of the French Indochina War in any systematic detail. It is the purpose of this thesis to provide a spatial understanding of French Paratroop Operations (*Operations Aeroporte*) or OAPs by developing a spatial database of airborne operations so that future research can examine the nature of airborne operations during the French Indochina War and how the spatial experiences of those involved in it influenced counterinsurgency doctrine used by militaries across the globe.

### 1.2 Background

Dien Bien Phu lies in the Tai highlands of northern Vietnam close to the border with Laos. When General Bigeard jumped into the besieged fortress to reinforce troops
and fight in the valley between March 1954 and May 1954, he was fighting against communist insurgents in the French colony of Indochina. Dien Bien Phu was the Gotterdammerung (the strict German translation is “twilight of the Gods”, but it is also used to describe a violent destruction, particularly during war) of French Airborne Forces in Indochina. Seven of nine airborne battalions were destroyed, representing the first major victory by non-western combatants against a modern western military force. It also represented the end to direct French control of the modern states of Cambodia, Laos, and Vietnam, as well as the transition to increasing involvement in Southeast Asia by the United States as part of its policy of containment in Asia.

The study of airborne operations in the French Indochina War and construction of a spatial database of combat jumps lies at the intersection of two subfields within geography: military geography and historical geographic information systems (HGIS). These two subfields have competing claims and interests, and this study will attempt to balance their biases to present an integrated database that is not embedded within the ontologies of any specific subfield to provide a thorough reconstruction of the landscape of OAPs during the War. There has been a renewed interest in military themed research in Geography over the last decade (Bernazzoli & Flint 2010; Cowen & Gilbert 2008; Enloe 2004, 2007; Woodward 2004, 2005). In “From Military Geography to militarism’s geographies: disciplinary engagements with geographies of militarism and military activities”, Woodward (2005) argues that Military Geography is limited by its coupling to the actual military organs of state, but can also engage in a discourse at multiple levels.
ranging from providing practical applications to military problems to critical analysis of how military functions and militarism alter the spatiality of societies.

Many scholars have engaged in a debate as to the policies raised by the Global War on Terror (Bacevich 2005, 2007, 2008; Boot 2003; Hersh 2006; Kagan 2006; Klein 2007; Malkin 2004; Priest 2003). It is evident from the literature that a discussion of military geographies has polarized the field between those who are primarily against such policies and those who generally are in favor. In addition, there are scholars who are directly serving in or supported by the military who do not engage in questions of ethics or critical analysis (Palka and Galgano 2005; Palka, Galgano, & Corson 2006). As noted by Woodward, they focus on the problem-solving aspects of military geography. It is within this vein of geographic inquiry that the use of technology is most prevalent in military geography.

Geographic information systems (GIS) had developed as an enabling technology for the collection, storage and manipulation of geo-referenced data. As such, GIS is used by researchers across different subfields within geography and other disciplines. Although GIS was first adopted by scholars in cartography and other forms of spatial analysis, it has slowly been adopted by other fields. HGIS, although relatively new within the lexicon of geography (Gregory and Healey 2007), is a GIS community that uses the science and technology associated with geographic information to analyze and understand historical processes from archival records. HGIS overlaps with other topical areas such as medical geography (Dorling et al. 2000; Orford et al. 2002). It has also given impetus to the construction of a National Historical GIS repository at the
University of Minnesota (McMaster and Noble 2005). Other countries from China (Bolin in Knowles 2008) to the U.K. and Russia (Gregory et al. 2002; Merzlyakokova 2005) have begun to develop highly sophisticated repositories of historical spatial data. These national projects in some cases exist outside of the purview of Geography. HGIS contributes to this thesis through the development of methods to handle translating historical data into a format that can be displayed in a GIS.

HGIS itself lies at the intersection between the analytical traditions of spatial analysis and the narrative tradition of historical geography. Although Holdsworth (2003) argues that historical geography provides a unique perspective on inquiries into and an understanding of past events, airborne operations in the French Indochina War and other conflicts are inherently spatial, and the nuances to understanding them can be better expressed geographically than by strictly using a historical narrative.

1.3 Thesis Outline

The remainder of this thesis is divided into four chapters. Chapter Two is a review of the literature that discusses research in military geography, historical geography and HGIS that provide the context for the current study. The literature review will also discuss Indochina: the history of the colony and the development of French Indochina. The chapter concludes with a brief narrative of the build-up of French Airborne Forces, and the underlying infrastructure supporting their operations during the French Indochina War. The literature review also highlights why French Indochina is significant in terms of current academic scholarship.
Chapter Three discusses the process by which data were collected and formatted for use in a geographic information system. It provides a review of the textual sources consulted for this thesis and a verification of those sources. It also discusses how the spatial clues found in these textual sources can be assigned to geographic locations for the airborne operations. This process reviews the components of different types of gazetteers used in the process as well as providing an overview of the errors that are inherent within the data, specifically, the plethora of temporal mismatch issues arising from geocoding a landscape that has been constantly evolving over the past sixty years.

This chapter also covers the theory and issues behind geocoding and discusses the differences between formal and informal geo-referencing techniques. It also will examine errors inherent in assigning a location that is essentially an area to a single point. Other issues associated with the various scales of airborne operations will be discussed. These data discussions form the basis for the construction of the point data layer representing airborne operations.

Chapter Four discusses the uses of the database and provides a discussion of issues of accuracy and precision that are inherent in the dataset. In a more informal context, the distribution of these locations will be discussed. This spatial context will be brought into a historical framework and the historical understanding of the French Indochina War will be discussed and measured against the spatial database. Chapter Five summarizes the limitations of this thesis based upon data and time restrictions. It also discusses how these two factors interact to constrict the types of analysis that can be performed with the available data. It concludes with a brief summary of the contributions
of the study to research issues in military geography, historical geography and HGIS. A better understanding of where the OAPs took place will underscore the importance of the experience of French Paratroopers as a pathway for understanding other developments in Southeast Asia and more distant fields of conflict.
Chapter Two

Literature Review

2.1 Introduction

As discussed in the previous chapter, the focus of this thesis lies at the intersection between the fields of military geography and HGIS. The origins and consequences of armed conflict are deeply connected to geography. Over the last two decades, a growing body of work has recognized the importance of military activities in shaping contemporary landscapes (Palka and Galgano 2005; Woodward 2005). Belcher (2011) has also noted the importance of historical data and experience in creating techniques to be used in current military operations. GIS has been recognized as an important tool that could be used in areas related to historical and archeological research (Chapman 2006). HGIS in particular can assist in the enhancement of archival records regarding bygone conflicts that still resonant in today’s memory. This chapter reviews the competing perspectives in military geography and the role that HGIS can play in analyzing the spatial nature of past military engagements. The chapter concludes with a history of airborne operations and a discussion of their development during the War.
2.2 Military Geography

It is difficult to define the subject of military geography. Any definition of it would not fully encapsulate the breadth of discourse and discussion that can be ascribed under the umbrella of “military geography” (Woodward 2005). As the field has evolved, two different perspectives on the subject have emerged, but defining the boundary between these competing perspectives is often very difficult. Military geographers can be loosely grouped into two camps—those who approach the subject from a focused quantitative positivist perspective (Beck 2003; Corson 2000; Doxford and Judd 2002; Doyle and Bennett 1997; Palka et al. 2006) and those who analyze it within the context of larger issues of state, geopolitics, culture, religion et cetera (Bernazzoli and Flint 2009a, 2009b; Cowen 2009; Dittmer 2005; Hannah 2006; Stump 2005). In general, the positivist approach examines military operations using quantitative methodologies to analyze data. Conversely, the critical approach examines the effects of military operations within the larger sphere of geographic inquiry, and uses broader terms such as “militarism” and more qualitative and critical methodologies.

Palka and Galgano (2005, v) argue that “Military geography is the application of geographic information, tools and techniques to military problems” (Palka and Galgano 2005, v); whereas, Woodward asserts that “studying military geographies means making a moral judgment to think critically not just about militarism, the moral basis of militarization and military activities, and the morality of the use of organized violence for political and economic ends, but also about the moral consequences of states of militarism and military preparedness” (Woodward 2005, 732). Woodward (2005) also
makes the distinction between “military” versus “militarism”. Within this field of study, the researcher often operates at the disjunction between quantitative and critical ontologies. Critical methods are better able to connect spatialities of transitory events across time, while quantitative methods can better describe physical relations amongst phenomena on the Earth’s surface, and also bring about a discourse of connecting these various geographies across time (Woodward 2005). It also extends thematically into other areas of geographic discourse such as population geographies (Tyner 2013).

However, within the discipline, military geography is a field that has not “developed” along the lines of other subfields of geography (Woodward 2005).

This has occurred for two reasons. The first is that “[military geography] has failed to develop along the pathways suggested by developments in the wider discipline, leaving it largely atheoretical, descriptive geography floating in the wake of a theory-powered critical social science” (Woodward 2005, 722). The second reason is that “Military Geography’s minority status revolves around the politics of its stated imperatives as an applied social science in service to military objectives” (Woodward 2005, 723). This would suggest that military geography has been relegated to a lesser role within the discipline as a whole because military geographers are overtly partisans in a discourse both for and against the institution of the military.

Although military geography has been described as “atheoretical” in nature and stunted within the development of a particular set of theories and dictums, a closer look at the research in military geography suggests that there is more theory than might be first suggested. Laswell (1941, 1962) hypothesized the concept of a “garrison state” and
proposed that the United States, along with other western states were moving towards being developed “garrison states”. Gross (1973, 1980) developed the concept the garrison state further. Bernazzoli and Flint (2010) and others also interpret the discussion of the ‘garrison state’ within the landscape of contemporary critical geographies. Their interpretation was at the individual level seeking to understand how two communities adjacent to Fort Campbell, Kentucky fit within the framework of a garrison state or community.

Another key development within current research in military geography ties into issues of geographic scale. Scale, and particularly large scale analysis, is an important component of geographic study. In terms of scale issues as a component of military geography, the state is treated as a collective of individuals (Megoran, 2006; Mueller 2008) and local governmental institutions become a focus of research (Burchell et al. 1991; Jessop 2002). Post-structural discourses of state (Hansen & Stepputat 2001; Mountz 2003) have also crept into the discourse of military geographies. The results of militarization and the discourse of militarism is therefore not treated as monolithic within a population, but diversified by locality (Painter 2006). Post-structuralism has pushed the scale of how we understand space to the smallest unit possible and is understood in human geography as relating to an individual.

In understanding these viewpoints, one could attempt to find a “value-free” definition of these two camps as being a discussion of how these two groups view the relationship between the institution of the military and space. One group studies how the variability of space affects the military as it functions in that space (Pincevičius et al.
2005), while the other group studies the effect that the military has as an institution on space. While this may be an over-simplification of the nuances of the two poles of military geography, for the purpose of this thesis this dialectic works because this thesis seeks to develop a spatial database that can be used with both quantitative and qualitative methods to explore these operations as an “indicator of space”.

Both sides of military geography provide valuable insight which to understand the French Indochina War. Indochina and later the constituent states of the Indochinese Peninsula were not monolithic entities at any level (Fall 1955, 1958, 1966; Pholsena 2008). Nor were the western powers consistent in their initial policy towards Indochina (La Feber 1975). Airborne operations during the War did not represent a uniform response to a united enemy. Rather, the spatial analyses for this thesis and the geospatial database of these OAPs will show that the Viet Minh were not an integrated entity across the whole of Indochina, but engaged in series insurgencies with varying degrees of local support.

2.3 The Role of Historical GIS

In order to understand the spatial patterns of OAPs during the French Indochina War as an “indicator of space”, the research in this thesis straddles the divide in military geography. Geographic information, tools, and techniques will not be used, as summarized in Palka and Galgano (2005), to solve military problems. Instead these methods and data will be used for a greater understanding of a historical conflict. A GIS approach is applied to historical study by constructing an historical database of campaign
operations from scholarly datasets. A review of the literature in military geography finds few examples that discuss converting textual descriptions of battlefield operations into spatial databases. One of the most important discussions of this relates to an understanding of the use of GIS during the First Gulf War. “The development of sophisticated computerized cartographic technology has in the last year, definitively altered the way in which modern warfare is fought and staged and the way it is consumed by a global public transformed into video voyeurs. By comparison, academic advocacy of GIS seems deliriously detached” (Smith 1992, 257).

GIS has also changed the ways in which the discipline of geography is perceived by other fields. The epistemological foundation of GIS has been one of contention dating to the explosion of the technology in the last decade of the Twentieth Century (Chrisman 1999). While initially being seen as an extension of quantitative studies (Chrisman 2005), the continued improvement of GIS technologies and methods has allowed it to be used increasingly in qualitative methodologies. As GIS has grown and matured, other sub-disciplines within geography, without the same quantitative emphasis, have begun to adopt GIS as an analytical tool in their own fields of interest. GIS has also been adopted outside of Geography in related fields such as Digital Humanities (Gregory and Healey 2007). Researchers in these sub-disciplines had to learn how to utilize GIS, the tool, and integrate their own methodologies and data into the framework of a GIS (Gregory and Healey 2007).

Among the many issues that were being discussed between various academics at the beginning of the 1990s were the issues regarding the implementation and impact of
Geographic Information Science (GIScience). A dialogue regarding the use of GIS in a societal context was laid out in the influential book *Ground Truth* (Pickles 1995). “An invitation from Pickles to write a chapter for his book (Goodchild 1995) was the first indication, to me at least, that a constructive dialog was more likely to help the cause of GIScience, and that the critiques were going to have a lasting impact—GIScience would never again be quite the comfortable retreat for the technically minded that it had been in the past” (Goodchild 2006, 687). As GIS absorbed input from other areas of expertise, specialized methodologies evolved for specific purposes in fields of study outside that of the traditional users of GIS.

Historical GIS (HGIS) is one of a plethora of specific applications that developed in the late 1990s (Gregory and Healey 2007). As a tool for analyzing the spatial relationships of physical remains, GIS was seen early on as an important resource that could be used in areas relating to historical and archeological research (Chapman 2006). Three advantages of using GIS in historical research have been identified by Gregory (2003). First, spatial database development can integrate disparate data sets through their geo-registration with respect to the surface of the Earth. Archives represent a vast source of data that can be interpreted and integrated into a GIS database for understanding the spatial dimensions of historical events that might have eluded modern scholars (Gregory and Healey 2007). Second, a GIS approach permits data to be visualized using maps and other geo-visualization techniques such as animations and virtual landscapes. Third, GIS allows different types of spatial analysis in which the coordinate locations of the features under investigation are an explicit part of the analysis.
As an epistemological element, HGIS should seek to strike a balance between quantitative and qualitative methodologies. In the construction of the database for the HGIS used here, the epistemology of historical discourse must also be accounted for to show an accurate expression of the historical events being recorded. Historical data are not always spatially accurate and these spatial inaccuracies must always be accounted for in a GIS (De Moor and Wiedemann 2001; Knowles 2008). Database construction has long been acknowledged as an important component in regional analysis (Berry 1964), and regional analysis of temporal events can show patterns that are often missed using conventional methods of historical analysis. Military operations such as airborne drops are explicitly spatial and temporal in nature and offer an opportunity to investigate the relationships between an event, its geographic representation, and the level of accuracy of that representation.

The specific database to be created is of paratroop drops during the French Indochina War between 1945 and 1954. Such a database could be used later in various analyses attempting to uncover new insights into the conduct of the French Indochina War (1946-1958). Some illustrative displays and analyses will be conducted as part of an accuracy evaluation of the database, but a full study of airborne operations in this conflict is outside the scope of this research.

2.4 Historical Background of Airborne Operations

There are three primary factors that guided the evolution of the structure of the French Far Eastern Expeditionary Corps (CEFEO) that was deployed to fight the French Indochina War between 1946 and 1954: 1) the territorial organization of Indochina; 2)
the French military was organized to control and defend the mainland and colonial possessions; 3) the experience of the French military during World War II (Jackson 2005). These three elements converge in Indochina and help explain the organizational lineage of French Airborne units as they were deployed during the period 1943-1954. The interplay between the physical geography of Indochina, the institutional development of the French Military, and the political pressures developed during World War II provide the subtext for the development and implementation of French Airborne units from 1945 to 1954 (Narme 2013).

The colony of French Indochina was conquered slowly during the later Nineteenth Century. By the beginning of World War II, French control of the Indochinese peninsula was extended to include what are now the states of Cambodia, Laos, and Vietnam. Vietnam, which was the most populous and economically important of the regions was itself divided into three distinct colonial units: Cochinchina, Annam, and Tonkin. Cochinchina was based around the Mekong River Delta with Saigon being the administrative center of the colony. Tonkin was centered on the Red River delta and the administrative center of this region was Hanoi. The region of Annam was not based around a river delta. Rather, it included the central highlands and the urban areas of Hue/Quang-Tri and Tourane (Da Nang). These five regions constituted the core administrative divisions of French Indochina.

Indochina, along with Morocco and Algeria, was considered to be an integral component of France. They represented the most important colonial possessions. To defend and pacify these territories, France developed a sophisticated military structure
based around several independent interrelated organizations. At the turn of the Twentieth Century, there were three main military organizations: the Metropolitan Army, the Colonial Army, and the Army of Africa. The Metropolitan Army consisted of troops recruited from mainland France. They were not allowed to be deployed overseas without specific approval from the legislature. The Colonial Army was created in 1900 from the earlier *Troupes Marine*, which is roughly equivalent to the United States Marine Corps. Colonial troops were all volunteer and composed of a mix of troops from mainland France and her colonial possessions. The Army of Africa was *de jure* part of the Metropolitan Army (pre-World War I it was constituted as the 19th Army Corps), but *de facto* became a separate organization composed of units that in many instances could not be deployed in mainland France without the consent of the government or in national emergencies.

The most well-known unit in the Army of Africa in the Twentieth Century was the French Foreign Legion. Based out of Siddi-Bel-Abbes in Western Algeria, the Foreign Legion was deployed through-out many colonies of the French Empire. In the 1930s the various Foreign Legion units stationed in French Indochina were grouped into a formation called the 5th REI (*Regiment Etrangere Infanterie*). By the beginning of World War II, Indochina contained a large garrison of troops from the Colonial Army and the Army of Africa (the French Foreign Legion). The origins of the French Indochina War lie in the breakdown in French military control of Indochina during the World War II.
According to the Treaty of Compiegne in 1940, France was allowed to maintain autonomy in all of her colonial possessions. This meant that the bulk of her navy and colonial forces continued to police their various territories. In Indochina, this was very complicated as Japan ideologically did not want Indochina to continue to be controlled by a European colonial power. Japan’s ally in Southeast Asia, Thailand, fought several border skirmishes and annexed sections of territory along the Laotian Border and the Cambodian Border. Although France was politically neutral and cooperated with the Axis powers, Japan slowly began to exert greater control over Indochina and began to station troops within the colony.

As early as 1942-1943, Free French Forces (those supporting Charles de Gaulle) who were now stationed in North Africa began to contemplate sending an expeditionary force to liberate Indochina from *de facto* Japanese occupation and bring the French garrison there ostensibly under Gaullist (referencing Charles de Gaulle) control. It is in this period from 1943 to 1945 that French Airborne Forces begin to develop. French Airborne Forces belong to two traditions in warfare, conventional and unconventional. The conventional tradition during World War II includes the D-Day parachute drops as well as Operation Market Garden in which airborne troops were dropped in comparatively large numbers to facilitate the offensive mobility of armies. The second tradition is one relating to unconventional warfare which today is known as Special Operations.

In the U.S Army, the 82nd Airborne Division is not seen as a “Special Operations” formation. However, similar paratroop units in the French Military structure are not
consistently classified. 1 RIPMa (Parachute Marine Infantry Regiment) is considered part of Special Operations but 2 and 3 RIPMa are not. This highlights the origin of the majority of French Parachute units in the realm of World War II unconventional warfare. Indeed the motto of the 1 RIPMa “Qui es Gagne” or “He who dares wins” is the same motto as that of the British SAS (Special Air Service).

The first unit that was deployed to the South East Asian sphere of operations was the Light Intervention Corps which was later renamed the 5th Colonial Infantry Regiment. This was an ad hoc unit which consisted of several commandos and a unit that was much larger than the others known as SAS B or Commando Ponchardier. Commando Ponchardier was a battalion-sized organization that was composed from all branches of the French Military and was the first operational parachute unit to deploy to Indochina (Bernier 1995).

However, the entire expeditionary corps that was deployed as a follow-on force to Indochina in 1945 did not end up fighting Japanese regulars. Instead, they were faced with moving into the vacuum that had been left by the Japanese Army. The forces that claimed to be in control of Vietnam at the time were the 20th Indian Army Division in the south and Nationalist Chinese forces in the North. From 1945-1946, France slowly reoccupied the colony first controlling the area around Saigon and then in 1946 dropping paratroopers onto several airports surrounding Hanoi in the north. In December of 1946, peace negotiations between the French and Viet Minh broke down and the First French Indochina War began.
Initially, there were relatively few parachute units in French Indochina. The bulk of them in 1945-1946 were constituted by the Commando *Ponchardier* and other smaller units. In 1946, two new battalions were raised from volunteers of parachute units then in existence in France. These two units were collectively known as the *Demi-Brigade Parachutist SAS* (DBPSAS). These units were based upon the aforementioned unconventional military forces. Although the DBPSAS contained two battalions, the total strength of the unit was only around 700 men. They were organized in a decentralized format unlike regular infantry units and based upon the maximum number of men who could be dropped out of one airplane thus maintaining flexibility and self-sufficiency.

Through 1946-1947, this unit was seen as being extremely effective and the French Military decided to deploy more parachute units along with an overall increased troop strength. It was felt that these forces were specially equipped to maneuver against what was then characterized as bandits and that with mobility and firepower they could locate contact and destroy the guerillas in inaccessible areas. The DBDMP (*Demi-Brigade de Marche Parachutiste*) or Marching Parachute Brigade was composed of full military units instead of new units from volunteers. The units involved were the 1st and 3rd Battalions of the 1st RCP (Chasseurs Parachute Regiment) and a newly raised unit, the 1 BCHOC (1 Shock Parachute Battalion). These units were deployed to the area around Hanoi in Tonkin while the DBPSAS were stationed around Saigon in Cochinchina.

It is in 1947 that a true pattern to French Airborne Operations in the French Indochina War. As the French Parachute Forces expanded, so too did the organizational
and logistical elements that were deployed to support the increasing operational tempo of these units. It was in late 1947-1948 that the last type of parachute unit was deployed to Indochina. In period, as the metropolitan troops who had signed on to fight in World War II and been illegally used for fighting in Indochina, the French began to develop Colonial Parachute Battalions. The DBPSAS was merged into the 1 BCCPSAS (Colonial Commando SAS Parachute Battalion) and finally into the 1 BCCP. This was then joined by a unit known as the 2 BPC and followed later by a third unit, the 5 BPC. The organization of these units also changed. From 1948 to 1950, these units were known as GCCP (Colonial Commando Parachute Groups). These units were again arranged in smaller units based upon a minimum drop unit of 15 troops.

After the period of 1947-1948, when the DBDMP was deployed to Hanoi, the Metropolitan military troops were slowly cycled out and replaced by a unit known as the GLAP (Group Leger Aeroporte) Line Parachute Group. This group was composed of the II Battalion of the 1 RCP, the 1 BEP (Foreign Legion Parachute Battalion) and the 3 BCCP (Colonial Commando Parachute Battalion). This might indicate an ideological shift from a view of the war as an extension of World War II to an emerging colonial war. In this period 1948 to 1950, the colonial units began to recruit local replacements to provide a local knowledge that would be critical during military operations.

In 1950 the French Indochina War entered a new phase with the establishment of a Communist China along the northern borders of Indochina and the increasing size and firepower of the Viet Minh units. The Battle of Colonial Route 4 (RC4) is seen as a watershed moment in this war as it marks the first decisive French defeat. Two complete
parachute units, the 1 BEP and 3 GCCP, were annihilated as combat units during the battle. The largest group of survivors that reached French lines numbered 29. With the defeat of a large French force in a conventional battle, an evacuation of Tonkin was briefly discussed. The new commander, Jean de Lattre de Tassigny, opted to stay and began to augment the personnel under his command through a greater use of local recruitment. He organized an indigenous Indochinese fighting force including whole Vietnamese parachute battalions and framed the Indochina War within the wider context of the geopolitics of communist expansion in Asia i.e., the Korean War and the Malayan Emergency.

The airborne battalions were once again reorganized the lines of conventional infantry battalions. They contained a larger headquarters unit and larger support staff at all levels. Entirely Vietnamese companies with their own force structures were also formed. At the same time, France announced the creation of the French Union, a policy meant to make colonialism more appealing to colonials, but also serving to create Federal armies for Cambodia Laos and Vietnam. As the Tonkin region began to become the cockpit of the armed conflict, the available theater parachute battalions migrated north. The Vietnamese parachute battalions were stationed near Saigon.

Laos and Cambodia each created their own parachute units with Laos having two: CCLP (Laotian Commando companies) and 1 BPL, a more conventional line parachute battalion. Cambodia developed the 1 BPK (Khmer Parachute Battalion). With the expansion of the national armies of Vietnam, Laos, and Cambodia, the combat value of French units was further diluted because French cadre for the Indochinese national forces
had to be culled from the CEFEO. At the same time, battalions such as the 6 BPC at Tu Le in 1952 were being dropped to act as a rear guard for French units retreating from the communist advance and taking heavy casualties that were difficult to replace. The development of the battalion force structure of French parachute units along with the build-up of national units during the war shows that the paratroopers needed to drop in ever greater strength so as to not be overcome by an increasingly sophisticated enemy. Yet at the same time, the expansion of airborne forces in Indochina was diluting the pool of available cadre from the French forces.

By 1952-1953, the total number of soldiers within the French Parachute Force Structure in Indochina was 10,000 troops. They were primarily stationed in Tonkin and used as mobile forces to destroy and pursue large Viet Minh elements or to free up the operational mobility of French ground forces. By 1953, the “jaundissement” or “yellowing” of the French army was become undeniable, especially in the paratroop battalions. The final force structure was based around nine battalions three of which were named as Vietnamese while the other six French in name only. In addition to those nine battalions stationed in Tonkin, one indigenous parachute battalion each was stationed in Laos, Cambodia and Cochinchina.

As the airborne forces expanded into Indochina markedly from 1947-1950, the force structures stationed in both France and Algeria also changed as well. Especially towards the end of the Indochina War, France was facing military commitments to NATO forces in western Europe and in the Korean War, and policing the remainder of the colonial empire in North Africa, West Africa, Madagascar and into the Indian Ocean.
and Pacific Ocean. Except for the Foreign Legion Parachute Battalions and the
indigenous parachute battalions, all colonial and metropolitan airborne units rotated back
to France and Algeria after a specific tour of duty. It must be noted that many of the
NCO and officer cadre that constituted the professional corps of the airborne units moved
from unit to unit and spent years far exceeding the length of a tour of duty in the colonial paratroopers. With this said, a complex organization in France and Algeria was created
to provide for a regular rotation of the airborne units.

During World War II, the largest unit of parachute infantry was the regiment. The
largest of these, the 1 RCP, was organized into three battalions and was part of the 1st
French Army from 1943-1945. Other regiments, notably the 2nd and 3rd RCP as well as
the Parachute Choc Battalions, were organized at smaller levels and formed to operate clandestinely. With the end of World War II, as the military commitment to Indochina
was still minimal, France attempted to create a Parachute Division along the lines of a
U.S parachute division such as the 82nd Airborne. It was meant to be comprised of all
available units and capable of large scale airdrops. Finding staff to form and manage the
combat formations was impossible. For example, the 24th Airborne Division, as a
military formation, lasted about three months (Narme 2013).

In 1946, the French once again attempted to form a conventional Airborne
Division from the available combat formations. This division was known as the 25th
Airborne division. The division was once again based in the South of France. It was
then transferred to Algeria as a peacekeeping force. This unit as well had trouble with
manning the entire planned force structure and again was unable to be formed along the
lines of a U.S World War II airborne division. It did develop the concept of a tactical unit known as an air-portable Group (GAP) on which the French Airborne forces in Indochina would be based from 1953-1954. The DBMP deployed from Indochina was also made up of elements of this division (I/1 RCP, III/1 RCP, 1 BCHOC). In 1947, the Colonial Troops raised airborne units. They were initially grouped in a single Demi-Brigade of Colonial Commando Parachutists (DBCCP). As this force evolved, it developed into two DBCCP one stationed in France and the other stationed in Saigon controlling the parachute battalions stationed in the south.

The Foreign Legion also maintained a separate airborne support structure. Beginning in 1947, two parachute battalions were permanently stationed in Indochina in varying locations. A third was raised and acted as a depot battalion to slowly feed replacements to these units to maintain strength levels. Coincidentally, the Foreign Parachute Battalions were consistently among the largest formations in Indochina. By 1952, the metropolitan formations had essentially disappeared, although a Colonial Formation, the 10th Colonial Parachute Battalion was renamed the II/1 Parachute Chasseur Regiment as a political gesture. By 1952, all French formations belonged to either the Colonial Army or the Army of Africa.

The first parachute operations connected to the French Indochina War actually took place in Laos in 1945. By 1954 five Vietnamese Parachute Battalions had been created. One Laotian unit was created and one Cambodian unit was created. These units were never as thoroughly deployed via airdrop as their French counterparts. Only three, the 1 BPVN (Vietnamese Parachute Battalion) 3rd BPVN and 5th BPVN were dropped in
combat. While in both instances they fought on with distinction, particularly the 5th BPVN at Dien Bien Phu (March 13th 1954-May 7th 1954) Vietnamese formations did not engage in many parachute drops. The same cannot be said for the Laotian Paratroopers. Starting in 1948 through to the end of the war, Laotian airborne forces were the primary unit of choice in conduction airborne operations in Laos. It was protecting Laos that provided *casus belli* for the preeminent battle of the French Indochina War: Dien Bien Phu.

This location straddled a river valley close to the Laotian border, it was hoped that the fortified camp which was reinforced to over 10,000 troops and designated GOMRN (Group Operational North West) it was intended to protect Laos for increasing Viet Minh incursions that began in force in 1952. Initially it was planned to station two parachute battalions (8 BPC and 1 BEP) there as a reserve force. Within hours of the initial attack the 5 BPVN was dropped into the valley. From that point on, due to a shortage of air transport, the remaining Airborne forces were dropped piecemeal into the battle such that by the end of the battle on May 7th 1954, there remained few airborne reserves (1 BPC [partial] 3rd & 7th BPVN) with a third Vietnamese Battalion, 6th BPVN forming. Two French units, the 7th BPC and the 3rd BEP were en route in U.S aircraft and arrived days after the surrender of the garrison. The French airborne formations were slowly moved south to Saigon and remained there until 1956 when the last of the CEFEO left the State of South Vietnam.
2.5 **Summary**

Military geography is caught in a divide between those who focus on military themes within the broader context of geography and those who focus on geographic themes within the broader context of direct military applications. In this thesis, however, the two perspectives are seen as complementary to one another. HGIS methods are proposed here not to be applied to military problems, but to aid in an understanding of how military operations act as an “indicator of space”.

The implicitly spatial nature of the narrative of the historical organization and deployment of French airborne operations suggests that the full spatial intricacies of the airborne experience in the French Indochina War may be uncovered through an explicit database of those operations. As this brief review of the history of airborne formations in Indochina indicates, there was a quick tempo and rapid mobility by these units. By evaluating these historical actions in a spatial database, one will gain a better understanding of this aspect of the French Indochina War. The next chapter discusses the data and methods used to create a spatial database of the airborne operations as they occurred in Indochina.
Chapter Three  
Data and Methodology  

3.1 Data Collection  

The French Indochina War presents a series of issues for spatial analysis. It was fought before the quantitative revolution occurred in geography and before technological advancements reached the point where spatial data could be gathered quickly and efficiently. The 1960s is a far more researched and data-rich period in terms of military operations in Vietnam. The War was fought on a tight budget, and before the beginning of the Korean War, it was fought without financial aid from the United States (Fall 1961). To find data regarding French Airborne Operations (OAP) is difficult. The main sources of information on the French Indochina War are limited to memoirs and a small literature on the history of the conflict.

Although information regarding the location of airborne operations is the most critical to this study, other datasets are also important to provide the spatial context of the operations. These sources include maps of French Indochina and information on the administrative organization and transportation infrastructure of the region. Most
important is spatial information that can be used to transform textual descriptions of
airborne drop locations into geo-referenced coordinates of those locations.

3.2 Textual Records of French Airborne Operations

While there is a small literature on the entire conflict, there is an even smaller
literature that focuses specifically on OAPs during the conflict. There are two key
primary sources regarding OAPs in French Indochina: *Histoire des Parachutistes
Français* by Paul Gaujac (1975) and *Paras d’Indochine* by Jean-Pierre Pissardy (1982).
The Gaujac book is a collectively authored book discussing the history of French
Airborne Forces from World War II (1939-1945) to the end of the Algerian War (1955-
1962). The book by Pissardy has a section titled *Operations Aeroporte* containing a table
of airborne operations during the French Indochina War that is used here as the primary
source for the construction of the spatial database of OAPs from 1946 to 1954. The table
contains 225 rows and 5 columns. The rows are organized in a chronological order while
the columns provide data on the date, location (within the location column, the region is
also included), a brief explanation of the mission (with a code name if the operation was
named), a count of the number of troops involved in the airborne operation, and a
breakdown of the military units involved (i.e. 3 BCCP, 1 BEP) (see Table 3.1).

*Paras d’Indochine* and *Histoire d’Parachutiste Francais* are referenced
extensively within the literature on the French Indochina War and these texts are taken as
the best and most extensive discussions of airborne operations during the war (Jackson
2005; Narme 2013). The table of airborne operations by Pissardy (1982) is therefore
treated as the basic list of all “official” operations during the French Indochina War that involved airborne units. Undoubtedly there were other OAPs where personnel and material were dropped during the war (Fall 1961; Fall 1985; Pissardy 1999). There were air transports of troops from one installation to another, but these were primarily a repositioning of forces, but for the purposes of this study, those operations will be excluded because the purpose here is the analysis of combat jumps.

In terms of assessing the accuracy of the aforementioned table, entries have been cross-checked with other sources to assess the overall accuracy of the table. Within the column that related to the mission of the airborne operation, higher level operations executed in conjunction with ground forces were oftentimes given codenames. Examples are Operation “Castor” which was the codename for the assault on Dien Bien Phu and Operation “Lea” which was a 1947 attack on the Bac Kan region of Tonkin north of the Red River Delta. All named operations were matched to other data sources (Adam 2009; Gaujac 1975; Fluery 1982) and cross-checked to make sure that no other named operations were excluded from this table. Dien Bien Phu, in addition to being the location for Operation “Castor” in 1953, was also the location of nine drops in 1954 according to the source table from Paras d’Indochine. These nine drops (again only referencing combat jumps) were matched up to other sources (Fall 1965; Gaujac 1975; Roy 1966).

While the probability of the existence of airborne operations not included in the source table is extremely high, the size and number of troops dropped is most likely extremely low. Most major operations that were conducted in conjunction with major
ground movements are contained within this table. However, the data as compiled from the table required further pre-processing before they could be imported into a GIS application.

Table 3.1

<table>
<thead>
<tr>
<th>Date</th>
<th>Lieu</th>
<th>Appellation et But</th>
<th>Eff.</th>
<th>Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>20/10</td>
<td>Nakhon Panhon (Siam)</td>
<td>Renforcer le groupe Tavernier à Thakhek</td>
<td>30</td>
<td>5th RIC</td>
</tr>
<tr>
<td>25/10</td>
<td>Nakhon Panhon</td>
<td>Renforcer le groupe Tavernier</td>
<td>30</td>
<td>5th RIC</td>
</tr>
<tr>
<td>12/11</td>
<td>Nong Khay (Siam)</td>
<td>Renforcer le groupement Fabre à Vientiane</td>
<td>11</td>
<td>DGER</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-20/1</td>
<td>Tha Ngon (Laos)</td>
<td>Renforcer le Groupe II à Vientiane</td>
<td>44</td>
<td>Commando Conus</td>
</tr>
<tr>
<td>27/2</td>
<td>Xieng Khouang (Laos)</td>
<td>Mettre sur pied la 1er Cie de Chasseurs Laotiens</td>
<td>10</td>
<td>Lt de la Casinière de l’ABC et 9 sous-officiers</td>
</tr>
<tr>
<td>24/4</td>
<td>Ban Don Noun (Laos)</td>
<td>Reprise de Vientiane et intimidation des Chinois</td>
<td>200</td>
<td>1er Bataillon SAS</td>
</tr>
<tr>
<td>9/5</td>
<td>Ban Sing (Laos)</td>
<td>Reprise de Luang Prabang et intimidation des Chinois</td>
<td>230</td>
<td>1er SAS – éléments du Cdo Conus (15) – éléments laotiens (14)</td>
</tr>
<tr>
<td>13-14/6</td>
<td>Sanakham (Laos)</td>
<td>Relever une section du 1er SAS dans le poste</td>
<td>39</td>
<td>Commando 5 du 2nd GCL</td>
</tr>
<tr>
<td>10/8</td>
<td>Siem Reap (Cambodge)</td>
<td>Renforcer et nettoyer le secteur</td>
<td>80</td>
<td>1er Bataillon SAS</td>
</tr>
<tr>
<td>24/11</td>
<td>Gia Lam (Tonkin)</td>
<td>Intimidation et prestige</td>
<td>288</td>
<td>1st Cie/1st SAS – 2nd Cie/2nd SAS</td>
</tr>
<tr>
<td>25/11</td>
<td>Cat Bi (Tonkin)</td>
<td>Dégager le terrain d’aviation</td>
<td>150</td>
<td>2nd Cie/2nd SAS</td>
</tr>
</tbody>
</table>
3.3 Constructing a Spatial Database of Airborne Operations

Proper construction of a database is essential for use in a GIS (Berman 2005; DeBats and Gregory 2011; Gregory and Healey 2007; Gregory et al. 2003). Most historical data are not spatially explicit (Gregory and Healey 2007) and must be assigned spatial coordinates so they can be displayed. Developing spatial data within a historic context is the most important component of HGIS (Berman 2005; Healey 2007). Many HGIS involved analyzing boundary changes of administrative polygons over time (De Moor and Wiedemann 2001; Gregory et al. 2002; Kristiansson 2000). Spatial data are very sensitive to the variable of time and much has been written about displaying time as a variable in GIS (Langran 1992; Langton 1972; Norris and Mouncey 1983; Peuguet 1994; Ott and Swiaczny 1998; Shepherd 1995). In addition to the issues of time, the variance in polygons also means that spatial data constructed from historic data also must account for the Modifiable Aerial Unit Problem (MAUP) (Openshaw 1984). To deal with this plethora of issues, many HGIS applications, particularly those which focused on places outside of Europe and the United States, have taken a novel approach to dealing with spatial data development.

As noted above, many HGIS projects are developed under the umbrella of a National HGIS. Harvard University operates, among other NHGIS, the Chinese HGIS. In dealing with the issues of political boundaries, the CHINHGIS has developed a methodology based upon displaying historic data using points instead of polygons (Berman 2005). This approach will be adopted to display the data for the airborne operations themselves—although a drop zone is not a single point, but rather a polygon.
When airplanes are dropping hundreds of troops over a given area, the troops do not all land within the designated drop zone (Fall 1985). The airborne operation that preceded the Allied landings at Normandy in 1944 did not accurately drop most troops within their intended drop zones.

The standard operating procedure developed to address this problem was for troops once on the ground, to walk in the opposite direction from which their planes were traveling (Windrow 2004). There were also designated rally points for troops to move towards. Ultimately, airborne troops were landed as close as possible to an objective such that they could easily reach it in the same day. These standard operating procedures were also used by the French in Indochina. Unless troops were being dropped to support a base, all operations took place during the day. Due to aircraft shortages it often took the available aircraft more than one trip to deposit all of the intended troops for a given operation.

These circumstances suggest that having precise boundaries drop zones is not critical for this thesis. Fine-scale analyses of individual operations might require knowledge of the boundaries of a given drop zone. The Chinese HGIS project out of Harvard uses points to represent administrative centers and then encodes the hierarchical level of these centers in the attribute table. This information is used to create a network analysis to describe the relationships among administrative centers. If polygons are needed Thiessen polygons can be created from a triangulation of the points (Berman 2005).
3.3.1 Pre-processing Steps

Several issues with respect to the original source table must be resolved before it can be processed to create a spatial database for use in a GIS such as ArcGIS. Before the development of software systems for handling geographic data, Berry (1964) conceived of a synthesis of regional analysis that lead to the construction of what he called a “geographic matrix”. His geographic matrix was as a method of understanding tabular data within the regional paradigm. He noted that “the intersection of any row and column defines a cell, and each cell is filled by a geographic fact, the characteristic identified in the row, and the place in the column” (Berry, 1964, 5).

This construct of the geographic matrix foreshadowed the concept of the attribute table in GIS. Many GIS are based on some form of a relational database model. The original ArcInfo software was organized around a geo-relational system that was a hybrid of a relational database system that linked an attribute table of characteristics to specially designed software to handle the geographic information (Morehouse 1984). In a geo-relational model, the set of geographic objects (parachute drops in this case) are organized as a set of rows in a table. There can be only one row corresponding to each object in this approach. The set of columns in the table correspond to the attributes of each object. Like Berry’s geographic matrix, the intersection cell of any row and column in a relational table should contain only a single fact. These systems requires that the cell value be “atomic” – meaning that it cannot decomposed into a list of other values (Worboys 1999).
The pre-processing steps were performed in Microsoft Excel and the source table (Table 3.1) was converted into an Excel spreadsheet. This is a file format that can then be imported directly into the ArcGIS software package for subsequent geo-referencing. In Excel, a formal field name is added to each column of data. The first task in restructing the original source table to make it compatible as an attribute table was to create a record for each airborne drop. In the initial table, there were rows that included multiple drops such as occurred in Operation Lea. Reorganizing the table around individual drops expanded the number of rows from 225 to 230. After this step, the new table was ready to be changed thematically so that the information in each individual cell was single valued and expressed as one type of data.

The first column in the original table recorded a date that contained both a day and a month. The year was inserted as a break in the table (see Table 3.1). A column showing the full date was kept as a single date entry, but three additional columns were created. Each of the three elements in the date was given a separate column so that individual records could later be aggregated by day, month, and/or year.

The second column in the original table included both a location and a region (the major administrative unit of French Indochina) that was listed under the location in a parenthesis. This column was expanded to two columns in the new attribute table. The regions of Cambodia and Laos correspond to present day countries while Annam, Cochinchina, and Tonkin correspond to the modern Vietnam. During the French Indochina War, these five regions were the fundamental organizations for the CEFEO (French Fare East Expeditionary Corps) as they fought in Indochina (Jackson 2005). By
separating the region from the specific locality of each airborne operation, later analysis can be performed at two different geographic scales – one at the scale of the five major administrative units of French Indochina and one at the scale of the individual places in the administrative units.

Next, the third column was divided into two new columns. Seventy-six records within the table contained mission names and the remainder did not. Those operations that were not named had null values for this field. The second new column contained a code for the type of operation the airborne troops were to conduct. The mission descriptions were translated and like operations were grouped together and coded using a common numeric value. Militaries have a whole range of approaches for categorization of military operations. Here, there is a slightly different situation where similar operations are being retroactively grouped together based upon a description of what occurred. The text description was written in French, and therefore needed to be translated. Across all 225 individual operations a series of similar words recurred:

- Bouclage = control
- Nettoyage = mop-up/ clean up
- Occuper = occupy
- Renforcer = reinforce
- Rechercher = search/find
- Detruire = destroy
- Reprendre contact = reestablish contact
- Intervention au profit de blessés = deal with the wounded.

Based on the recurrence of these words, the airborne operations were coded into eight categories in order to capture succinctly the essence of the airborne operation’s purpose and to group operations of the same type. The following numeric codes were assigned:
1: secure and mop-up operation  
2: reinforce post  
3: destroy supplies/raid  
4: occupy area/post  
5: reinforce ground units  
6: cover a retreat  
7: independent operations  
8: dealing with casualties.

It is important to understand that not every operation fit neatly within a category. For instance, on May 21, 1949, a group of eleven men from a command element of the airborne units in Indochina dropped at Nghia Do for liaison operations. This does not specifically fit within a discussion of any of these operations. In this coding system, it was placed under the category “7: independent operations” to show that the airborne drop is operating primarily without any cooperation with ground forces in the area.

The fourth column contained data regarding the number of troops dropped during a given operation. The total number ranged from 7 to 4,535 paratroopers. This column was split into two new columns. The first contained the raw count of troops present in the drop. The second new column was a classification of what type of unit was dropped based on the troop strength (Jackson 2005). The coding for type of unit was:

- $\leq 10 =$ Section  
- $10<$ and $\leq 35 =$ Platoon  
- $35<$ and $\leq 65 =$ Company  
- $65<$ and $\leq 300 =$ Multiple Companies  
- $300<$ and $\leq 900 =$ Battalion  
- $>900 =$ GAP (Group Aeroporte [Airborne Regimental Combat Team]).

It must be noted that these troop ranges are not always indicative of the level of unit involved in the operation. It provides a soft estimate to allow one to generally compare the size of the forces involved.
The last column of the original table stated which military units were involved in each drop. To come up with a unit size that was dropped, column four and five are used in consultation with each other. Due to military losses and the expansion of the force structure, the paper strength of a unit and the number of troops available for a military operation were often not the same (Fall 1961; Jackson 2005; Narme 2013). The 5th column of the original table, which expresses the specific units involved, was then broken down into multiple columns. If the overall unit dropped was a composite unit, the component pieces were expressed within that column.

After the elements of the original table were entered into the spreadsheet, Excel was used to calculate two new data fields. Because the original table lists the airborne operations in chronological order, a new column of data was constructed that contained the number of days between two consecutive operations. This was calculated by subtracting the date value for the first operation from the date value for the second operation. Next, the number of days that occurred between a particular operation and the very first operation was calculated by subtracting the date of the first operation from the date of every other operation.

Once the original table was pre-processed to create an attribute table for the individual airborne operations, the next pre-processing step involved constructing an attribute table for the individual regions where the operations took place. These are the five administrative units of French Indochina and the country of Siam. The three operations in 1945 were all in Siam. The operations in Siam were retained in the table even though they occurred outside of French Indochina. For analyses focused solely on
Indochina, they can be excluded. In addition to recording the total number of missions and the total number of troops involved, these attributes were also broken down by individual year. This required the addition of twenty new columns to that the attribute table of individual airborne operations in Excel. There were ten new columns for each year that had a value of one for the year column in which the operation occurred and a value of zero otherwise. The other ten columns for each year had the troop strength value in the year column in which operation occurred and a value of zero otherwise.

The Excel file representing the expanded OAP data table was then imported into ArcGIS. After opening the attribute table of the file, a data summary table was calculated based on the region field. In summarizing the original column data by region, only information on the number of missions and the troop strength of those missions was retained by choosing to “SUM” those fields. The text information found in the other columns could not be easily summarized and were not kept by this summary step. The summary table was created as a new text file which was then opened in Excel again and saved as an Excel file. This Excel file represents the attribute table for regions. The next section discusses the process and problems related to the geo-referencing the geographic features found in the two new attribute tables.

3.3.2 Geo-referencing the Data

The expansion and reorganization of the initial source table into two attribute tables ensures that every row of each table is associated with only one geographic feature. A fundamental requirement for GIS databases is that each feature stored in the database
must be geo-referenced in either a geographic coordinate system of longitude/latitude or in a projection-based system of \(x,y\) coordinates. All coordinate data must be referenced to the same datum (the mathematical model of the Earth) or else the features will not be properly geo-registered with respect to each other (Chang 2008). This is what Hill (2006) refers to as “formal” geo-referencing. Formal geo-referencing provides a “feature’s” “footprint” on the Earth. Hill (2006) notes that these footprints are the basis for calculating distance and direction, and for defining spatial relationships (Alberto and Thomas 2007).

In contrast, a historical archive usually has at best some form of informal geo-referencing associated with the features described in the archive. Informal geo-referencing is accomplished with place names, addresses, postal codes and other types of geographic descriptions used in everyday life. Such informal geo-references do not possess any metric property (Longley et al. 2001), and thus cannot be used in metric forms of analysis. Informal geo-references, however, can be converted into formal geo-references by the process of geocoding (Chang 2008). Geocoding can take different forms. As mentioned in the previous section, location information in the database is given for two geographic scales – that of the major administrative regions of Indochina (Tonkin, Laos, Annam, Cochin-China, and Cambodia) and that of the nearby town, village or physical feature where the operation occurred. The geocoding procedure differs for these two scales.

The easier geocoding is associated with the regional scale. For this geocoding, a digital map of the five regions was created. First, the current country boundaries of
Indochina and different layers of administrative units in Vietnam were downloaded in ESRI shapefile format from the website Diva GIS. Next, a map of the historical boundaries of French Indochina was scanned from Pissardy’s (1982) study of airborne operations, and rubber-sheeted in ArcGIS to fit the historical boundaries to the modern digital boundaries. The map layer containing the finest administrative units for Vietnam was overlaid on the historical map, and the best fit of these administrative units to the historical regions of Annam, Cochinchina, and Tonkin was used to assign each administrative unit to a historical region. The dissolve operation in ArcGIS was then used to merge the individual units within each historical region into one polygon for each region. The three resulting polygons follow the boundaries of the geo-referenced map. After all OAPs were geo-coded (the details are given later in this next section), their point locations were cross-checked to make sure that they were within the proper regional boundaries. The final regional map was prepared in a shapefile format so that it could be used in conjunction with the other data layers in ArcGIS (Figure 3.1).

The attribute table for this new regional layer has an attribute field containing the name of each region. This field is a key that can be compared against REGION field in the Excel file containing the thematic information regarding the number of drops and the troop strength to order to perform a join operation. The join operation is a commonly used task in GIS that links together attribute fields associated with features in one table with attribute fields for the same feature in another table (Chang 2008). Because there are only five features in the Indochina shapefile, but there are six features in the Excel
Figure 3.1 Screen Capture of Modern Polygons being Matched Against Historical Boundaries. Sources: CIA Atlas of Indochina (1970), www.diva-gis.org/gdata

attribute table (Siam was also a feature in that table), only the attribute information for the five regions of French Indochina are joined to the shapefile. Once the join has occurred, the current shapefile is exported as a new shapefile to make the appended information a permanent part of the shapefile of French Indochina regions.

The process of geocoding the point location for the individual airborne operations is more difficult and labor intensive because it deals with more features and the informal
place name geo-references are not as familiar as those of regions within the colony.

Modern GIS technologies derived from GPS data can provide locational measurements to the precision of a foot. Although GIS has the ability to accurately and precisely display spatial data, in the case of historical data, one cannot take advantage of that precision because the primary textual data sources are not very precise. Even maps that accompany the textual information often lack the requisite accuracy if not drawn by a professional cartographer. For example, Pissardy (1982) included several maps locating selected air drops in different regions for different years. Figure 3.2 displays a GIS based upon one such “sketch” map of operations for Annam during 1948 and 1949. Such a map shows the general area where the operations occurred but not accurate positions.

Figure 3.2 Representation of the Pissardy Map of French Airborne operations in Annam during 1948 and 1949 Source: Pissardy 1982, p. 174
Accuracy unlike precision, however, does not relate to how precisely the data is expressed, but how closely the data are to expressing a “true representation” of the location. While these two concepts are related, they are not the same and an accurate but imprecise location is better than a precise but inaccurate one. Another factor affecting the acceptable level of accuracy required by the database is the scale of analysis. Precisely measured information may be valuable for fine scale data analyses, but this study is being conducted at a regional scale. Also, the events that are being measured cover a range of individuals that participated from under ten to over four thousand in number. Thus, the precision of measurement is not necessarily as important as the accuracy of the point representation of the drop zone. Digital gazetteers provide an important resource for converting informally geo-referenced data into formal coordinates that can then be used for spatial analysis (Goodchild 2008). Gazetteers give the longitude and latitude coordinates for places and are often associated with topographic map series.

Each place name in the compiled attribute table of airborne operations was used in a search to find a match in one of the digital gazetteers. The major issue using digital gazetteers in other countries is not in translating the informal locations to formal locations, but with translating the specific words that comprise a place name. There are three separate major languages, Khmer, Lao, and Vietnamese, used in the different countries of Indochina. The locations expressed in Table 3.1 represent a rough normalization of the language on the part of the author based on Latin characters that were originally written in other scripts. The basic process for taking such languages and converting them into English script is first to transliterate them, by turning the native
script into Latin script while maintaining all phonemic elements and indicators from the original script. The second step is to normalize the transliterated script by forming the constituent grammatical elements into words and cleaning up the other orthographic markers to allow for easier reading. The final step is the actual translation from the parent language into English words which are entered into the digital gazetteer search engine.

GeoNames.org, a web-based gazetteer, providing domestic and international locational information for place names has algorithms to automate the translation process, but the system may still return multiple names and coordinates when the user enters a place name. Figure 3.3 illustrates the issues involved in this process for the place name “Nghia Lo”. When this occurs, the user must rely on other data to make an accurate decision as to the correct selection of from the list returned by the gazetteer. The search results menu provides sufficient information to make an informed decision regarding the correct location. The “Country” column confirms that each location is within the correct country. The second column gives displays the type of feature associated with the place name – populated place, second-order administrative division, third order administrative division, et cetera. The last two columns provide the latitude and longitude information. These two columns are especially helpful because Vietnam primarily lies on a north/south axis and the three regions from the colonial period lay within specific bounds of latitudes.
Figure 3.3 Display of Nine Separate Locations Returned by the “Nghia Lo” query in Geonames.org.

The fourth record in the results screen shown in Figure 3.3 would not be an accurate location because the latitude/longitude coordinates for that record lie outside of the region, Tonkin, which the OAP database associates with the place name “Nghia Lo”. Other data sources such as political boundaries which were previously downloaded and geo-referenced and Pissardy’s sketch maps were examined to ascertain the most accurate latitude/longitude coordinate for this location. Based on the information provided by the search engine, the query for “Nghia Lo” is associated with the second record and its coordinates were used to define the location of that air drop. Although the OAP table has 230 individual records, certain locations such as Sam Neua in Laos and Dien Bien Phu in Tonkin were places that had repeated Airborne Operations. This aided in the geocoding process because once a location was identified the coordinates could be used for all subsequent operations there. The second record in Figure 3.3 has a logo that, when clicked, connects to the Wikipedia page for the given location.

Not all records from the OAP table could be formally geo-referenced through this method. Again, issues in translation between languages that did not use the same writing system as well as temporal issues prevented a one hundred percent match rate. A
potential problem associated with the digital gazetteers initially used in geo-coding the air
drop locations was that the time frame for the informal geo-reference from the historical
document was almost fifty years prior to the time frame of the digital gazetteer containing
the formal coordinates. The fifty year period means that not only have these areas
changed significantly in terms of size, orientation, and land area, but also the specific
places might have been renamed or, if they were in a border region, been moved from
one administrative area to another administrative area either internally or between two
countries. To address and evaluate this temporal mismatch, a second set of gazetteers
were downloaded from websites affiliated with the digital archives at Texas Tech
University containing American military gazetteers from 1967. Through a search of this
virtual archive of the U.S Vietnam War, the VC/NVA-RVN gazetteer developed by the
Army Corps of Engineers and published December 1966 was discovered and accessed.
This gazetteer is associated with and acts as a reference guide to the Army Map Series
L7014 of 1:50,000 scale maps of Vietnam. Using this resource addresses many of the
issues associated with using later gazetteers for geocoding. Army translators accurately
translate the named locations into English so there is no language error when conducting
a location query. The gazetteer describes the nature of the location, whether it was a
hamlet, regional administrative center, or some type of physical feature (see Figure 3.4).
This gazetteer also presents place names as used by the Viet Cong and North Vietnamese
Army (VC/NVA) as well as the equivalent name used by the Republic of Vietnam (see
Figure 3.4). Coordinate values used by the VC/NVA are provided along with the
corresponding UTM coordinate values. The VC/NVA map sheet containing the place
Figure 3.4 A Sample Page from the VC/NVA-RVN Gazetteer, Volume II, RVN, 1966

name, as well as the L7014 map sheet containing the place name are also given. Figure 3.5 presents the spatial organization of the L7014 map sheet series for South Vietnam.

The cross-referencing of names in the gazetteer increases the likelihood of finding a given place name for any feature. Searching for place names is also aided by the alphabetical organization of place names in the system used by the US Army and the RVN.

A final advantage of this gazetteer is that UTM coordinates are given in six digits – three for the longitude value and three for the latitude value. In the UTM referencing system these values are displacements from the origin of the map sheet given in meters.

For example, place name in the gazetteer is “A Ba Yu Can” which has a UTM coordinate of YC879609 found on map sheet 6540-IV. Figure 3.6 presents this map sheet. The grid overlaid on the map has a resolution of 1000 meters. The value “879” is the longitude
displacement given in 100s of meters and the value “609” is the latitude displacement. A coordinate pair formed by the first two digits of each displacement (“87,60” in this case) corresponds to the vertices of the grid. The third digits are used to pinpoint the location within each grid cell.

Figure 3.5 The Set of Map Sheets included in the VC/NVA Gazetteer. Source: VC/NVA-RVN Gazetteer, Volume II, RVN, 1966.
Figure 3.6 An Example Topographic Sheet that Covers the Atun Area of Vietnam. Source: The University of Texas Website
Although there are many advantages to this gazetteer, there are two main drawbacks. First, the gazetteer only covers place names located in the Republic of Vietnam (South Vietnam). Second, the UTM coordinates must be converted into longitude/latitude coordinates which is the formal geo-referencing system of the airborne spatial database. A second historical gazetteer was found that did not have these drawbacks. The gazetteer titled *Index to Names on the 1:50,000 Maps of Vietnam Series L7014* was downloaded from the Perry-Castañeda Library Map Collection. This gazetteer covers the entirety of Vietnam and directly gives the coordinate values in longitude/latitude as well as UTM coordinates (see Figure 3.7). Only the RVN name for a feature is given. The main limitation is that the UTM reference only gives two digits for the displacement values and the longitude/latitude values are given to the nearest minute. The UTM value would correspond to a vertex location on the map grid of the 1:50,000 scale map as discussed above. The nearest minute restriction is not a serious problem. Given that at the latitude range is so close to the equator the coordinate would have a precision of about one mile. This is entirely appropriate when one considers that an airborne operation can drop upwards of six hundred to over a thousand troops on airplanes in formation that cover an area of a couple of square miles.

The last and important feature of this data source is that it is accompanied by an extensive map series that covers all of Vietnam. The 15 minute topographic maps that correspond to these gazetteers were downloaded from the library website at the University of Texas. These files have spatial reference data encoded in them so they can be incorporated into a GIS as raster data layers. GeoPDFs are a new type of PDF that are
being used in conjunction with 15 minute topographic maps.

A second type of file format is GeoTIFF. These files are just like normal .tiff files, they have spatial data embedded so that they can be used in a GIS. For the software and computers available for this processing, the GeoPDFs needed to be converted to GeoTIFFs to facilitate this process and a series of programs were run in a shell to speed up the process. It took two and a half hours to process the 505 items downloaded from the University of Texas website. Once these map sheets covering all of Vietnam were data mined, the downloaded files will be used at a later time to conduct a mosaic of the
Indochina area. Map series L7011 and L7016 covers Cambodia and Laos is covered by L7015 and L7012. The process by which these files will be constructed into a single georeferenced raster image of Indochina is discussed in the next section.

3.3.3 Creating Raster Images from GeoPDFs and GeoTIFFs

With the increasing trend to leverage computing capabilities and processing speed, how paper maps are used has changed dramatically over the last two decades. As noted above, PDF (Portable Document Format) and TIFF (Tagged Image File Format) files have begun to have spatial data encoded within their formatting. These data allows image and maps from various sources to be scanned and integrated into a GIS for analysis. This is a relatively new form of data management, and currently ArcGIS 10.2 does not have the capabilities to read these variants of traditional file formats. To allow for the spatial data to be accessed within the ArcGIS program without using proprietary software is a process that involves the use of various open source software packages.

For the purpose of creating a single raster mosaic of all topographic maps, the Cygwin Bash shell was used for spatial data handling and processing of the files. Cygwin is a command prompt interface. By using the GDAL (Geospatial Data Abstraction Library) utility, the individual files can be merged similarly to the mosaic tool within the ArcToolbox of ArcGIS. Once this function has been completed, the finished mosaic can then be brought into ArcGIS for use as a basemap layer over which various data layers and the OAP data layer can be drawn against the topography of the area. This highlights the importance of programming as a tool to help the spatial analyst
process large amounts of data quickly. To cover the four different countries where airborne operations took place during the French Indochina War (Cambodia, Laos, Thailand, and Vietnam), a large amount of data from the various 1:50,000 map sheets had to be processed. For example, 500 individual geoPDFs and geoTIFFs were processed to prepare the images for Vietnam to process these using a GUI interface is not feasible. ArcGIS is not constructed to process vast numbers of layers simultaneously easily. Having an external shell to process the data files outside of Arc and then importing the result is the most efficient way to prepare the images.

Once a mosaic of the raster images has been completed, the points of the airborne operations could be digitized using the mosaic as a reference backdrop, and a comparison could be made to determine how well the gazetteer geocodes matched the points generated by screen digitizing from historic maps. The encoding of spatial data into the digitized copies of the 15 minute topographic maps makes the interpretation of these maps far easier than standard HGIS processes. Many NHGIS projects must assess the quality and composition of historic maps and often times these maps cannot be geo-referenced to then be completely digitized (Berman 2005). The availability of this data source compiled from accurate maps from the study period eliminates the need to follow the involved process of digitizing historic maps that are not spatially correct.

3.3.4 Metadata

Metadata is data about the content, quality, condition, and other characteristics of data and geospatial metadata is important because it provides information needed to
process and interpret the data. In the case of this study, it is very important to have a good metadata protocol, because this thesis is constructed using a plethora of data sources. Also, because it relies heavily on material aggregated from a variety of sources across a variety of different locations, it is imperative to have clear and concise metadata to allow the product to be uniform in nature. Finally, because a number of different methods may be used to construct the final database, metadata regarding the pre-geo-referencing process for each OAP was also constructed. Then the final database is used for subsequent analyses, it will be important for the analyst to know how each coordinate and attribute value was compiled so that appropriate analytic methods can be used. The metadata associated with the compilation of the longitude and latitude location for each operation includes the name of the digital gazetteer source used for each operation, the historical gazetteer source used for each operation, whether the place name listed in the Pissardy table of operations matched the place name listed on one of his sketch maps, and the actual name used to find a match in both types of gazetteers. In addition, based on all of the factors involved in ascertaining the coordinate location of the place name, a qualitative assessment is given for the confidence level for each final location. It is also only fitting that a database describing the history of events that occurred in a particular era should also contain the history of the data used to describe those events.

3.4 Preliminary Analysis Methodologies

It is not sufficient only to develop a dataset. That dataset must be useable and provide meaningful information for analysis. If the database is not properly constructed,
then the effort put into its construction has been wasted. Therefore, a series of preliminary analyses were conducted to provide meaningful insights into airborne operations. These analyses will draw on several characteristics of the data. The most detailed and accurate component of the data source is the temporal information about the airborne operations at different scales: yearly, monthly and daily. That aspect of the data will be used as the basis for a series of exploratory graphical displays and maps to demonstrate how this data source can be used to describe aspects of airborne operations during the French Indochina War that have not been fully explored either temporally or spatially.

By using Microsoft Excel as the basis for constructing the database, the functions and tools in Excel can be used to construct graphs, as well as importing the file into ArcGIS for spatial analyses. The first series of analyses were done using the Excel file itself to create a series of graphs explaining the temporal distribution of the airborne operations. Then maps at a regional level were created to show the regional distribution of OAPs. A series of maps were created to show the distribution of airborne operations. These maps will display the airborne operations showing what type of unit (i.e. metropolitan, colonial, foreign legion, native, combined) was involved in the operation. This will provide an overall understanding of the changing command structure. Following that a series of maps will be constructed to show the annual nature of the airborne operations. The drops will be displayed, again in the same four map structure showing in which months of the year these operations took place.
3.5 Summary

GIS analysis of historical data sources provides a unique set of challenges to the spatial analyst. An extensive amount of pre-processing is often necessary to make the original data set suitable for use in a GIS. Use of gazetteers requires analysts to account for variances in language and script and to translate those entries into modern representations of their original forms. In the case of this thesis, multi-value data cells within the source data table had to be deconstructed so that only one variable value was being expressed in each cell. This meant that an expansion of the table was necessary.

Metadata management is a key task in providing context for geographic data. In the construction of this spatial database, the metadata was partly encoded into the table with additional sources added later to provide the user with a proper understanding of the sources and limitations of this dataset. The digital gazetteers provided an important data source in geo-coding the informal spatial data of the source table.
Chapter Four

Geocoding Results and Exploratory Analysis

4.1 Introduction

In this chapter, the results of the geocoding using two different approaches are presented and evaluated. Based on the results of the evaluation, a decision was made on which coordinates to use in the final version of the spatial database. Once the database was compiled, a set of exploratory analyses were conducted demonstrating the types of information that can be extracted from the spatial database. These analyses also demonstrate the value of having a spatial reference for the data in comparison to working with the data from a completely non-spatial perspective.

4.2 Evaluation of Geocodings from Different Sources

At the core of this study, is the question of how best to translate informally geo-referenced or “fuzzy” locational data into formally geo-referenced features that best represent the location of airborne operations during the French Indochina War. After the pre-processing step to prepare the original table information as an attribute table, the
attribute table contained 230 records representing informally geo-referenced airborne operations over a period of 3,207 days from the first recorded airborne operation on October 20, 1945 to the final airborne operation on July 1, 1954. As discussed in the previous chapter, the summarizing and geocoding of these operations at the regional level was fairly straightforward. The boundaries of the five regions of French Indochina were geo-referenced from only one historical map using the method outlined in Chapter Three. No evaluation was performed with respect to the accuracy of these outlines because the outlines would be used primarily to serve as the base map against which the locations of individual airborne operations would be displayed or to make thematic maps, such as a proportional symbol map (see Figure 4.1), at the regional level.

However, at the level of the individual operation it is important that the locations are proximate to where the airborne drops actually occurred. The Pissardy sketch maps provide an initial indication of the approximate locations of 177 of the operations. Multiple sources of both digital and historical paper gazetteers were then consulted to geocode the locations for each individual location. In most instances, the informal place name referred to a populated place, but in some cases, the place name referred to a river or even an island. As discussed in Chapter Three, the primary concern over the accuracy of digital gazetteers was that the spatial data used was developed from the current locations within the countries of Cambodia, Laos, and Vietnam. To provide context and move the geocoding temporally towards the time period in which the airborne operations took place and the locations as they existed in the time period 1946 to 1954, historic military and state department gazetteers developed during the United States involvement
in Southeast Asia were used to see how different the coordinates used to located these places were over a time period of almost fifty years.

Figure 4.1  The Number of Airborne Operations by Region, 1946-1954
For the evaluation comparison results from the two different sets of gazetteers, the three missions in Siam were excluded. These missions all occurred in 1945 and are outside the region of interest for this study. The digital gazetteers mainly used in geocoding the remaining 227 missions were geonames.usgs.gov and geonames.org. One hundred and sixty place names were found using geonames.org and sixty place names were found using geonames.usgs.gov. The remaining seven were found were found using Google Maps. As noted in Chapter Three the actual source used was recorded in the metadata for the geocoding of each operation. In contrast, for the historical gazetteers compiled between 1966 and 1973, only 215 place names could be found. For both sets of gazetteers there were often a number of features having the same place name. As mentioned in Chapter Three, the coordinates were chosen for a feature that was located in the same region as stated by the historical source data table. For Laos and Cambodia this was not a problem because there were separate gazetteers for both countries. However, for both the digital gazetteers and the historical gazetteers there was no separation of the regions of Annam, Cochinchina, and Tonkin. The choice of feature for these regions was primarily made based on the latitude of the gazetteer feature. All locations in Vietnam could then be double checked by displaying these features against the regional reference map discussed above. If the feature was outside the correct region, the gazetteer was searched for an alternative location until one was found within the correct region in the vicinity shown on a Pissardy map if available.

The twelve features for which coordinates could not be found in the historical gazetteers were removed from the evaluation because no comparison of their locations
could be made. The remaining 215 features were then evaluated by the distance separating the geocoded locations for them from the data sources. Root mean square error (RMSE) and mean absolute deviation (MAD) were the statistics used in this assessment. RMSE is a common statistic used to compare different coordinate locations for the same feature in GIS (Chang 2008). MAD is not used as much for evaluation of coordinate locations but it is less sensitive to extreme values than RMSE.

The first step in evaluation was to calculate the distance between the coordinate pairs representing the same place name. First, the Excel spreadsheet containing the attribute tables of individual missions was imported into ArcGIS. The display (x,y) data option was used to display the features on the screen. In this option, the longitude and latitude for the digital gazetteers was chosen for the location. This step created an “event” theme in the map display. Next, the event theme was exported as a shapefile which was added to the map display. The attribute table of this shapefile contains the longitude and latitude for both the digital and historical gazetteers as separate fields.

Finally in ArcToolbox, the “XY to line” tool under the DATA MANAGEMENT/FEATURES menu was used to create a line segment connecting the two pairs of coordinates. In this analysis, the lines were created as great circle lines. Figure 4.2 shows the resulting lines. The red dot on the map represents the location of the feature from a digital gazetteer; at the other end of a line is the same feature location according to a historical gazetteer. The longer lines show more disagreement between the two systems. As seen in Figure 4.2 the largest disagreements occurred in Cochinchina. ArcGIS was also used to calculate the length of each displacement line in
Figure 4.2  The Displacement Distance between the Two Gazetteer Systems

meters. The maximum length was 301.8 kilometers which is about 187 miles. This was for the “Nui Tran” mission in Cochinchina. Overall, the RMS value was 24.3 km and the MAD value was 4.9 km. The difference between the two measures shows that the RMS values were affected by a few extreme distances. Overall, 64 missions had the same location, the locations for 159 missions was within 2 km of each other, and the location for 201 missions were within 10 km of each other.

The final question is which geocodes should be used for these 215 features. The top priority was given to the location in the vicinity of the one shown on a Pissardy sketch map regardless of source. Second, given that the historical gazetteers from the US
involvement in Vietnam are closer in time to the era of the French Indochina War, it was decided to use the coordinates obtained from these gazetteers over the digital gazetteers, if there were differences. The historical gazetteers are also compatible with the historical GeoTiffs for future research. In preparing the final spatial database then, the historical gazetteer coordinates were used for the 215 operations for which these coordinates could be found, and the remaining twelve operations (Figure 4.3) were given the coordinates.
found by using the digital gazetteers. Figure 4.4 shows the 215 airborne drop locations geocoded from the final set of 227 mission locations.

Finally, a confidence level was associated with each location. It was assessed based on the difficulty of determining the location from the place name. Places like Dien Bien Phu in Tonkin, Sam Neua in Laos and Kontum and Pleiku in Annam are well known and their locations were extremely easy to determine. A higher confidence was associated with missions whose general locations were given in a Pissardy map. More confidence is also associated with missions having almost the same coordinates from both historical and digital sources. Low confidence is associated with locations found without any reference on a Pissardy map and that had different names between the digital and historical gazetteers or many potential matches to choose from. Overall, the qualitative assessment ranged from maybe to somewhat, moderately, very, and extremely confident.

4.3 Exploratory Analyses

French Airborne Operations are inherently spatial in nature. The ability to negate the difficulties of ground movement through terrain during combat allowed for the ability to place troops practically anywhere. However, as shown in scholarship of the French Indochina War, airborne troops were far from decisive during the conflict (Le Mire 1980). Yet, analyzing these airborne operations can still provide valuable information. Paratroopers were greatly feared by the Viet Minh and their movements as well as their officers were tracked by Viet Minh intelligence (Fall 1961). The database as presently
Figure 4.4 The Final Locations for the Set of 227 Airborne Operations
Figure 4.5 Qualitative Confidence Assessment
constructed allows for the spatial nature of these airborne operations to be expressed over time. The perceived value on the part of the Viet Minh of the parachute units as well as the influence that these soldiers had on French Military doctrine (Bigeard 1957; Trinquier 1965; Galula 2006) and French society (Foucault 1975; Tolbert 1976) show that there is an enduring historical value to the experience and spatiality of French airborne operations.

The spatiality of these operations was influenced by real factors on the ground, and due to the high-value nature of French airborne forces, they were committed to only the most important missions. However, the majority of the operations conducted by any parachute battalion were not via airdrop. Only those missions deemed essential involved an airborne drop given the scarce air transport resources. These operations can then be understood as representing the most important targets of the French command in Indochina. This chapter will illustrate how the spatial database of these operations can be “deployed” in analyses to illuminate the temporal and spatial nature of these targets.

The temporal nature of longitudinal datasets such as the airborne events of the French Indochina War has posed problems for GIS analysis. Langran (1992) describes an “event” as a temporal object that is the equivalent of a spatial object used in a geographic context. An event has neighboring events in time that occur before it and after it just as spatial objects have neighbors that occur near them. Displaying an event simultaneously in both time and space is difficult. For a temporal analysis, the spatial aspects are often either ignored or the individual events are summarized over larger areal units, whereas
for a spatial analysis the events are summarized by time periods. The next two sections describe different analyses from these two perspectives.

4.3.1 Temporal Analyses of Airborne Operations

The first analyses describe how airborne operations occurred over time. As discussed in the previous section, one spatial database was prepared at the level of the five administrative units (also Siam in 1945). In this database, the characteristics of the operations are summarized by region and by year. The data on year was used to show the growth and decline in the frequency of operations as well as the strength of these operations over time as measures of operational tempo. Because the focus is on the temporal component and not the spatial, the analysis was performed using Excel rather than ArcGIS.

From 1945 to 1949, there was a steady increase in the frequency of operations by year (Figure 4.6a). After 1949, there was a continuous decline in these operations. This type of bar chart can be made for any temporal sequence of summarized events. No geographic information is included other than all events occurred in French Indochina or Siam. In Figure 4.6b, the same frequency of operations by year is shown with each bar divided into six potential segments whose length is determined by the number of airborne operations that occurred in each region during the year. This chart shows very clearly that over the course of the conflict, different regions were involved in different stages of the conflict. First, all operations in 1945 occurred in Siam and none occurred there after 1945. Second, the number of airborne operations in Laos stayed fairly constant,
especially from 1949 to 1952, while Cambodia was the target of very few operations throughout the entire war. Within Vietnam, Cochinchina was more of a focal point for these operations in the first half of the conflict. The number of operations peaked there in 1949, a year when the region had more operations than any other. The number of airborne drops in Annam grew slowly, but after 1948 it became the region with the second highest total number of operations. Finally, Tonkin was clearly the region with the most drops over the entire period. After 1946, Tonkin became the focal point of airborne operations. Although Figure 4.6 does not convey the explicit spatial arrangement of the airborne drops, it does give insight into the regional patterns of the conflict over time.

A second temporal analysis shows that while the overall number of airborne drops decreased yearly after 1949 as the war progressed, the aggregate number of troops that actually participated in operations increased substantially over the course of the war, peaking in 1953 (Figure 4.7a). Airborne operations in the conflict ceased after the fall of Dien Bin Phu in the first half of 1954. This suggests that the combat capabilities of the Viet Minh grew during the course of the war and the French increased their troop strength to counter the Viet Minh. Figure 4.7a again does show this increase in troop strength in the entire study area; Figure 4.7b breaks down these annual values by region. In this figure, it is evident that the 1945 operations in Siam were very minor. Very few troops were also involved in operation in Cambodia. Laos was dominant only in 1946, but the number of troops was relatively small within the context of the whole war.
(a) The Number of Airborne Operations by Year

(b) The number of airborne operations by year and region

**Figure 4.6** Temporal Frequency of Airborne Operation by Year
(a) Total Airborne Troop Strength by Year

(b) Annual Troop Strength by Year and Region

Figure 4.7 Temporal Frequency of Airborne Troop Strength by Year and Region
Troop strength for Annam was fairly consistent between 1948 and 1952 and then increased dramatically in 1953 as the conflict approached its climax. In contrast, the level of troop strength for Cochinchina was greatest in the first half of the conflict and, in 1949 more troops were involved in operations in this region than any other region. After that year, however, its relative share decreased over time. Tonkin was again the dominant region for almost every year of the war and, since 1950, accounted for more than half of all troops in each year. Figures 4.6 and 4.7 show that over time, as the conflict intensified, the main front of operations was the region of Tonkin. The French would win or lose based on their efforts there.

While the analysis by year and region describes the overall operational tempo of the war, the summary by year masks the day-to-day aspects of this tempo. The second temporal analysis describes the operational tempo from the perspective of individual operations. First, the time interval between successive individual events series is graphed over the series of all 230 events. Figure 4.8 shows that the period of greatest temporal intensity of airborne operations in terms of the fewest number of days between operations occurred between 1949 and 1950; from May 1949 to July 1949 there were twenty-seven missions and only one occurred more than ten days after the previous one (and that gap was only thirteen days). This period marked the high point in operational tempo, that the 1949-1950 period, airborne forces were deployed in a more “tactical” role while they were used later on as a strategic reserve for only the most important missions. Less frequent missions also placed less strain on the available air transports.
**Figure 4.8** The Operational Tempo of Individual Missions

**Figure 4.9** The Operational Tempo Compared Against Troop Strength
A related disaggregated temporal analysis plots the number of the troops involved in the operation against the day the mission occurred in terms of the number of days since the first mission of the conflict. Overall there were 3207 days between the first mission in Siam and the last mission in Laos. Figure 4.9 shows that during the first half of the war no mission involved more than 1000 troops. The first mission involving more than 1000 troops occurred on November 14, 1951. Although the graph does not display it, all missions having more than 1000 troops occurred in Tonkin. This graph again shows the increased tempo of the war during 1949-1950 as well as another increase in tempo in the last stage of the war in 1953 when the missions are bunched together.

The temporal analysis of airborne operations corresponds to a degree with narrative accounts of the progression of the French Indochina War (Fall 1961; Porch 1991). These accounts have concluded that the war developed through several distinct phases. The first phase started with the beginning of the war and stretched to the end of 1947 with the end of a series of operations to eliminate the Viet Minh insurgency in Tonkin called Operation Lea. Figure 4.9 shows that this period was a relatively light period for airborne drops also. The second phase 1948-1949 is marked primarily by the absence of large scale operations on either side. It is at this point that the French Indochina War was framed as an insurgency. Although the airborne drops of this period were not as large as those towards the end of the war, as noted above they increased in frequency. The period of 1950-1951 marks the third phase of the conflict. This period was marked by a large defeat, at the battle of Route Coloniale 4 and the dispatch of Jean de Lattre de Tassigny to Indochina to assume overall command of the conflict. With
respect to airborne operations, the frequency began to decline although the size of
mission increased. This phase ended in 1951 when de Lattre returned to France to be
treated for cancer. The last phase from 1952-1954, while lasting three years instead of
two, was characterized by a continuity pattern of almost continual, large scale conflict in
Tonkin and Annam as well as the slow movement of the Viet Minh from their base areas
towards northern Laos. It was this threat that was the reason the French high command
decided to install a fortified camp at Dien Bien Phu. It was during this phase that
airborne operations played their most important role.

4.3.2 Spatial Distribution of Airborne Operations by Phase of the War

The phases in the war also exhibit rather different spatial patterns. The broad
regional differences were noted in the previous section. The spatial pattern of the
individual missions during each phase of the war is equally important. For this analysis,
the missions are summarized by time period rather than by geography and the results are
displayed in a series of maps rather than graphs. In addition to the overall spatial pattern,
the missions are also classified by type of unit in order to investigate any changes in the
deployment of these different forces available to the high command. As discussed
earlier, French parachute units were of several types: metropolitan, colonial, Foreign
Legion, and Indochinese. Sometimes multiple “types” of units were deployed in one
operation and those operations are designated as combined.

The map for the first phase (Figure 4.10a) is interesting for several reasons. First
almost all airborne operations were executed by metropolitan troops. Most were focused
on Hanoi in the north, and to a lesser extent on Saigon in the south. In Cambodia, there are two operations that occur roughly in the region of Siem Reap. Laos was the target of operations in its northern section along the border with Siam, while the waist of Indochina and most of the coastal areas have no airborne operations whatsoever. This map shows the connection that this phase shared with World War II in that many of the troops deployed to Indochina also had been in the military for the duration of the Second World War.

Figure 4.10b shows the first change in the spatial nature of the Indochina conflict. First, during this phase hardly any operations occurred in either Laos or Cambodia. During this phase, Annam becomes the focus of airborne drops, and operations intensify in the north and south. With respect to the types of units involved, there is a marked drop in the number of metropolitan parachute units while there is an expansion in the diversity of units involved. This reflects an expansion in the development of airborne forces. The development of colonial and foreign legion forces meant that metropolitan units formerly deployed to Indochina as a result of World War II could now return to France or other parts of the colonial empire. Colonial troops were volunteers and Foreign Legion troops were raised among non-citizens of France. Another interesting aspect of this phase is the number of operations that occurred along the Chinese and Thai borders as well as along the coastal areas. This represented an attempt to isolate the Viet Minh from bases of support. The northern operations also reflected the flow of the civil war in China which by 1949 was won by communist forces who actively reinforced and supported the Viet Minh in their quest for independence.
First 4.10c shows the beginning of the overall decrease of operations as well as the continuing decrease in the use of metropolitan forces for the fighting in Indochina. Again, other than small operations, the interior of Indochina was still relatively devoid of airborne operations. Compared to the south, the north is now the main center of airborne operations, especially the preponderance of operations in the area of the Red River. The operations are slowly moving from east to west in Tonkin as well. This was in part because of a major French offensive to retake the city of Hoa Binh. There was also a clustering of operations in Annam centered on the Da Nang area. The absence of airborne operations in both Laos and Cambodia, indicates that these regions were relatively peaceful, and as noted earlier after 1949, Cochinchina was not nearly as contested as earlier in the war.

The final map (Figure 4.10d) depicts the last phase from 1952-1954; it shows an increased number of operations in Northern Laos and Tonkin. This indicates an increase in combat in the T’ai highlands around the Laotian border as well as into northern Laos. There are some operations along the coast around the Da Nang area and along the coast in Cochinchina. Another interesting feature of this map is the virtual disappearance of metropolitan troops and the increase in the use of Indochinese airborne forces. Particularly in Laos, these forces were extensively used which suggests that there were segments of the population that were highly motivated against the Viet Minh. In the final phase, the missions are also not very concentrated but spread across the entirety of the Indochina Peninsula.
Figure 4.10 The Spatial Distribution of Airborne Missions, by Phase and Unit Type

(a) Missions during 1946-1947
(b) Missions during 1948-1949
(c) Missions during 1950-1951
(d) Missions during 1952-1954
A combined view of all airborne drops from 1946 to 1954 (Figure 4.11), shows several interesting features. First, there is a concentration in each of the three constituent regions of Vietnam (Annam, Cochinchina, and Tonkin). Both Cochinchina and Tonkin represent the highest proportion of airborne drops. Unlike the other regions, Laos displays a widely dispersed series of airborne drops that were not centered on the territorial capital as is the case in Annam, Cochinchina, and Tonkin.

**Figure 4.11** The Spatial Distribution of all Airborne Missions, 1946-1954
4.3.3 Seasonal Nature of Airborne Operations

As mentioned in Chapter Two, Indochina is located between 9 and 23 degrees north latitude. This latitude and location in Southeast Asia gives Indochina a predominant tropical monsoon climate. The monsoon winds are southerly to southeasterly during the months from May or June until September or October when the winds shift and come from the north and northwest from October or November until April or May. The period of the southerly winds is the rainy season whereas the remainder of the year is fairly dry. This seasonal pattern of wind and rain is as important as the total amount of rainfall. Particular times of year are more likely to have adverse weather for airborne and other military operations. Overall, weather played an important role in military operations during the French Indochina War (Fall 1961; Fall 1965; Pissardy 1982; Roy 1966). Particularly at the battle of Dien Bien Phu, weather was seen as a deciding factor in terms of restricting the resupply capabilities of the French (Tolson 1971; Tokar 1989).

Figure 4.12 shows the average annual rainfall for all of Indochina and insets for selected places show the seasonal distribution of that rainfall. It also shows the direction of monsoon winds for different locations. The general pattern of seasonal rainfall varied from place to place. In Tonkin, identified as the main area of operations during the entire war, the dry season was from October to March. Following that, a wet season occurred where the monsoon rains severely restricted the capabilities of air operations. The pattern is similar in the Saigon area although the average rainfall is higher there.
Figure 4.12  The Spatial and Seasonal Distribution of Rainfall in Indochina

Figure 4.13 displays the spatial pattern of airborne operations aggregated into four
three-month periods: January-March, April-June, July-September, and October-
December. The interval January-March is predominately a dry period and July-
September is predominately wet period; the other two periods are transitional.
Comparing Figure 4.12 with Figure 4.13, it is interesting that several areas that have low
precipitation particularly in central northern Laos were areas where airborne operations were conducted almost with impunity. One area where there is a relatively strong correlation of rainfall and the execution of airborne operations is along the coast of
Annam. There the rainfall occurs primarily in the last quarter of the year, and there are few airborne operations that occurred along the Annam coast during those months. This suggests that areas that did not have quite the same operational tempo as Tonkin did follow seasonal cycles when conducting airborne operations.

These patterns can be seen more clearly, when the spatial patterns are viewed for the different phases of the war. Figures 4.14a and 4.14b shows the time of year that airborne operations were conducted during the first two phases of the war. In Tonkin, despite the influence that the rainy season had on the ability to conduct airborne operations, the French were willing to conduct operations throughout the entire year with practically no decrease in operational tempo. The period identified in the temporal analysis that contained the highest operational tempo of the war stretches from December 1948 through the rainy season of 1949. While the average of troops dropped during this period was about that of company strength, it shows that the time of year was not a deterrent in conducting airborne operations (Figure 4.14b).

During the last two phases of the war (1950-1954), which saw the development of the war to its climax, Figure 4.15 shows that in Tonkin the French forces did not avoid conducting airborne operations during the rainy season as well, although they did not quite conduct it at the same tempo that was done in Figure 4.14. This could be due to the increasing size of these airborne operations which required more planes and thus made formation flying for an accurate drop on the targeted area more difficult.
4.4 Conclusion

These analyses demonstrate the value of this dataset to display basic characteristics of the airborne operations during the French Indochina War. Perhaps the most important information derived from these analyses is the importance of the location of Sam Neua in Northern Laos. Sam Neua, while not the site of the highest number of total drops, had drops conducted there across the greatest number of years. This suggests that this area was far more important to the conflict than previously suggested. An analysis of the transportation system during the period shows that Sam Neua was a key node in the road network from the Hanoi region into Laos.
During 1947, in a series of related operations, airborne troops dropped along Colonial Route 6 to ensure that Hanoi was connected by land into northern Laos through Sam Neua. This suggests a possible recalibration of the “turning point” of the war. Conventional scholarship suggests that the battle of Colonial Route 4 was the turning point of the war because it meant that the Viet Minh had a base area from which they could retreat and train men with impunity. In 1951, the French retook the city of Hoa Binh. Hoa Binh also lies along Colonial Route 6. After this battle was won by the Viet Minh, France lost a road link into northern Laos. If this connection had not been severed
perhaps there would have been no need to use Dien Bien Phu as a base to protect northern Laos because Sam Neua could have been used instead. In addition to the effects in northern Laos, the data suggests that there was also a link between the Battle for Hoa Binh and what was going on in Annam. From 1948-1951 when airborne operations first started to be conducted in Annam, the number of troops dropped on a yearly basis stayed relatively stable. However, in the two years after 1951, the number of troops that were being dropped into Annam increased dramatically. These analyses show the importance of this database to conducting studies of airborne operations in the French Indochina War.
Chapter Five

Conclusion

5.1 Introduction

The purpose of this thesis was to develop a methodology for geo-referencing French Airborne Operations during the Indochina War (1946-1954). To develop such a process, literature from several geographic subfields including military geography and historical GIS was reviewed. In addition, historical narratives of the use of airborne troops during the French Indochina War had to be consulted to develop an understanding of previous scholarship as it related to this thesis. A Geographic Information Systems (GIS) is the tool that can be used to store and display such data in a way that, if done correctly, can allow for other data to be superimposed onto the initial database to process the data to uncover hidden connection and specific landscapes.

5.2 Overview of Geocoding Methodology

The geocoding methods adopted reflect the fact that historical data are often informally geo-referenced and are not displayed in a spatially accurate manner. Historical texts describing the locations of events most often using place names; this provides a qualitative indicator of location. Quantitative coordinate information can then
be obtained for these place names by using gazetteers and related sources. Sometimes the text will also include informally drawn maps, and these maps often will contain markers of the events described in the text to give the reader a basic spatial understanding of the patterns of these events. This connection is extremely important for evaluating the suitability of coordinate information obtained from a gazetteer because of numerous issues that arise when using gazetteers to match place names with coordinates.

5.2.1 Issues Associated with Geocoding using Gazetteers

The historical database used to construct a spatial database of French airborne operations contained several elements that introduced error in the processing and manipulation of the data. These errors affected the precision and accuracy in the construction of the spatial database. The field used to geo-reference each individual airdrop contained two informal geo-referencing elements, a place name and a regional name. The place name was rendered in English without any diacritical markings while the regions were rendered in French. In the cases of both accuracy and precision, the ability to represent a place name that is expressed in a foreign language using a script different than Latin characters contributed the uncertainty of whether or not the correct location had been chosen.

The three languages in which the place names were normally expressed are Khmer, Lao and Vietnamese. These languages are not easily translated to English, and therefore the paucity of linguistic data within the source document contributed to the amount of error in data processing. To geo-reference these data points, two different types of gazetteers were used, digital and historic. In the case of the digital gazetteers,
GeoHack, geonames.usgs.gov, geonames.org and Google Earth, each type posed different types of challenges in aligning the textual name with a name in the gazetteer database. The two geonames websites, one unofficial, the other run by the U.S. Government, returned multiple names for each entry. The geonames.usgs.gov website had an option to turn diacritics off. Each entry would often return 10-20 possible locations for a single location. To process each entry, the regional location needed to be used as often those names that were widely different in coordinates were not in the same location.

Historic maps from the Pissardy (1982) book were used to “frame” the possible locations of any set of coordinates. When a suitable location was selected, the coordinates in the digital gazetteers were converted from degrees, minutes, and seconds into decimal degrees. This provided a certain precision, although the gazetteer data sources might not necessarily have been accurate. To provide a point of comparison to the geo-referenced points from the digital gazetteers, a set of historic gazetteers assembled during the time of direct U.S. involvement in Southeast Asia was used to provide a cross-reference point for each airdrop. Although it was hoped that these sources would detail names similar to those in the Pissardy text, these sources posed many of the same issues that arose from using the digital gazetteers. The same labels were often spelled differently. In many cases locations’ multiple locations were provided for the same name and gazetteers provided less precise coordinates than the digital models, reporting coordinates only to the degree and minutes. This means that at least
some of the error in analyzing the two locations selected for each data point comes from the precision variance in the two sources.

The accuracy error is an issue because the historic gazetteers represent the spelling of each place name in yet a third way. This makes it exceedingly difficult in attempting to find the “true” name to provide an accurate location. Only 215 of the 227 points were found using historic gazetteers sources. This then raises the question of why 12 points were not found, and whether their names were changed or the places were so small as to be overlooked by the U.S. survey. This second choice seems unlikely as several of the locations such as Phu Doan, were not contained in the historic gazetteers yet represent well known locations in the modern countries. The inability to surmount the linguistic barriers as the database was constructed is the primary reason behind the accuracy issues in the finished dataset. Further research into the linguistics of each writing system must be conducted to improve the ability to interpret various spellings of the same place, or two find other renderings that were overlooked.

5.2.2 Methodology for using Gazetteers to Geocode a Historical Dataset

For this research, the Pissardy (1982) book contained a table of all of the spatial data which greatly simplified the step of textual extraction. The location of each record was then identified in the table and each of these locations was then cross-referenced with the maps at the back of the book. Those records that had a corresponding location on a Pissardy map were viewed as having a chance of greater confidence in the final geocoding than those that were not mapped out by Pissardy. Another important aid for
resolving these issues was the fact that the regions of historic Indochina were included in each record so that not all of Indochina needed to be searched with respect to each operation.

After this had been done, each location was entered into a digital gazetteer search engine using the place name and the current country. For this research, geonames.org was the primary search engine used while geonames.usgs.gov was used as a secondary search engine. As discussed earlier, one advantage of digital gazetteers is that the search engine will also provide name variants and their associated coordinates. A list of all variants and coordinates is kept in a temporary file for further reference.

Next, the historical gazetteers were used in a similar hierarchical manner. The primary sources for location coordinates in Vietnam were the U.S. Government’s Gazetteer Number 58: Southern Vietnam and the South China Sea (1961) and the U.S. Government’s Index to Names on 1:50,000 Maps of Vietnam, Volumes II (1967). Secondary Historical Gazetteers for back up of a complete Vietnam were Gazetteer Number 79: Northern Vietnam (1964) and the U.S. Government’s Index to Names on 1:50,000 Maps of Vietnam, Volumes I (1967). The source for Laos was the U.S. Government’s Laos Official Standard Names Gazetteer, Second Edition (1973) and for Cambodia is was the U.S. Government’s Gazetteer Number 74: Cambodia (1963). No secondary historical gazetteers were available for either Laos or Cambodia. The original name from the source document was used first in a search through the appropriate historical gazetteer. For Vietnam, if the original place name could not be found in the primary gazetteer, then the secondary gazetteer was used. If no place name match could
be found in any historical gazetteer could be found then close name variants from the
digital searches were used.

It is at this point that researchers must use their own judgment in assigning a set
of coordinates to the specific event that is being geocoded. The decision rule was to find
the closest fit between names in the historical and digital gazetteers as well as the points
that are close to the locations indicated on the Pissardy maps. When the set of
coordinates had been decided upon, then coordinates from the digital and historical
gazetteers respectively were then entered into the database. In the final step, a subjective
choice was made between using the digital gazetteer or the historical gazetteer coordinate
as the final coordinate for mapping and analysis purposes. This judgment is made on all
of the available evidence including the informal maps. As shown in this study often the
digital and historical coordinates are the same. Metadata are used to identify all of the
choices made for each step. This full process is outlined in Table 5.1. Once the database
was compiled, it could be then be used for different types of exploratory analyses.

5.3 Discussion of Database and Exploratory Analyses

The historic database used to construct this spatial database can be broken down
into contained three different “themes” of information; temporal, spatial and descriptive.
While Section 5.2 discussed the errors in developing formally geo-referenced records
from the informally geo-referenced source material, both the temporal and descriptive
aspects of the historic database were more precise and accurate. It was these two parts of
the database that were used to provide a series of exploratory analyses to provide
examples that show proof of concept. The temporal data were extremely useful as each record contained the year, month and day of each airborne operation. With this data, a time series could be displayed showing the intervals to the day between each airborne operation.

**TABLE 5.1**
Steps in the Geocoding Process

<table>
<thead>
<tr>
<th>Step</th>
<th>Task Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Extract the place name for each event from the source historical document.</td>
</tr>
<tr>
<td>2</td>
<td>Match each place name to any map provided in the source document to determine the relative location</td>
</tr>
<tr>
<td>3</td>
<td>Input each place name into a Digital Gazetteer Search Engine to develop a list of place name variants and coordinates.</td>
</tr>
<tr>
<td>4</td>
<td>Cross-check each name variant within the appropriate Historical Gazetteer to find the set of coordinates that are closest to each other and location on any informal map.</td>
</tr>
<tr>
<td>5</td>
<td>Enter each set of coordinates into a spreadsheet with metadata fields designating sources and alternate names for original place name.</td>
</tr>
<tr>
<td>6</td>
<td>Repeat steps 1 to 5 for every event in the database.</td>
</tr>
</tbody>
</table>

This provided some very interesting results showing the period of greatest operational tempo in airborne operations was the period of 1948 to 1950 which is known as a quiet period in the overall conflict. This suggests that airborne forces were used differently during this time period than the other periods during the war. Other analyses were conducted at the yearly scale, breaking down operations by year by region, to show how airborne operations changed over the course of the war. Descriptive data relating to
the number of troops involved in each individual drop was aggregated by region to show by year how many troops were dropped, and then by region by year how many troops were dropped.

While these analyses conducted at such a large scale were very coarse spatially and temporally, they still show the value of the database in providing a greater level of insight than the narrative alone. The descriptive data, relating to what military formations were involved and how many troops were dropped in a single event, were not as explored as much during these analyses as they could have been. The primary reason was issues in geo-referencing each record.

5.4 Future Research

This research has provided a greater understanding of how difficult it is to develop a spatial database regarding events that occurred before the computer technology advances of the 1960’s that allows data to be more easily translated into coordinate points for use in a GIS. With the vast amount of historic data that is available, more accurate methods of geo-referencing must be developed. Future research relating to this thesis is can be considered at two levels: research specific to the French Indochina War and research specific to HGIS. To understand more fully the role of airborne troops within the context of the Indochina War and the period of decolonization after World War II, travel to not only Southeast Asia to collect archival and spatial data from the actual sites to France to access French archives, and to various locations in the United States to access more complete data sources would be very valuable. In terms of pushing the field
of HGIS forward, more research must focus on understanding how to manipulate and use historic gazetteers, and how to possibly leverage CyberGIS to process the vast numbers of data points within each volume. Having a digital version of each historic gazetteer would greatly facilitate the geo-referencing process.

5.5 Bigeard

This thesis began with the story of General Marcel Bigeard, perhaps the preeminent French paratrooper, and his wish to have his remains returned to Indochina, although he left Southeast Asia in 1955. Many commentators believed that Bigeard provided the inspiration for a number of fictional portrayals of French paratroop officers in both print and film (Tolbertt 1976; Horne 2006). His story underlines the importance of a synthetic view of Geography where quantitative analysis alone is not enough to understand spatial relationships. In the case of General Bigeard, he directed operations affecting the outcome of the war and the landscape of the region. His experiences were similar to thousands of others who fought by first jumping out of an airplane. The temporal and spatial patterns of airborne operations in the French Indochina War illuminate the myth of the French paratrooper.
BIBLIOGRAPHY


Bigeard, Marcel, and A. Lenoir. 1957. "Contre guérilla."


Chapman, H. 2006. Landscape Archaeology and GIS. Stroud, United Kingdom: Tempus.


