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IDENTIFYING GEOSPATIAL SIGNATURES OF AL-QAEDA IN THE MAGHREB

ABSTRACT

On September 11, 2006, Al-Qaeda lieutenant Al-Zawahiri released a statement officially aligning Algeria's Islamist militants, the Salafist Group for Preaching and Combat (GSPC) with Al-Qaeda and publicly transformed the GSPC's identity into Al-Qaeda in the Islamic Maghreb (AQIM). What new agenda of action did the GSPC's repositioning on Al-Qaeda's ideological and political terrain and international gaze produce? Two time periods will be addressed: the GSPC's era of Al-Qaeda allegiance (2003-September 11, 2006) and the AQIM period (September 11, 2006 to present). This analysis will apply geospatial predictive modeling techniques to open source documentation of GSPC and AQIM events in Algeria to inductively discover spatial patterns about the GSPC's convergence with Al-Qaeda.

INTRODUCTION

GENERAL ANALYTIC QUESTION

What patterns engender the GSPC's political realignment as a new Al-Qaeda affiliate (AQIM) and their theater of operations after September 11, 2006? As a complementary line of analysis, Maghrebi and COIN analysts suggests that in accordance with the GSPC's allegiance to Al-Qaeda from 2003 to the time of the official 2006 merger, the group's network of associations, ideology, and tactics bore the marks of Al-Qaeda (Knight 2009 and Black 2007, 2008). Accordingly, geospatial signatures of attacks committed by AQIM proper and by the GSPC during its years of informal Al-Qaeda influence shall be evaluated and compared in order to consider the extent to which the formal announcement of the new insurgency entity AQIM altered the tactical theater.

GEOSPATIAL COROLLARY

What geospatial "signatures," or relationship between event data and spatial factor data, define the GSPC terrorist incidents during its allegiance to Al-Qaeda and its subsequent absorption by Al-Qaeda, as the new group Al-Qaeda in the Islamic Maghreb? Using Open Source event data on AQIM and GSPC terrorism incidents, as documented by the National Counterterrorism Tracking Center's Worldwide Incident Tracking System (NCTC WITS), what locational factors—including life, physical and intellectual spaces—can be correlated, either as attractors or repellents, with their respective operational theaters. Did the GSPC's ideological and political repositioning with Al-Qaeda-- jihad within the West, the establishment of an Islamic caliphate—result in a new signature of attacks? If so, what are the spatial signatures, and did they emerge with the official merger with Al-Qaeda, or did they already exist during the GSPC's informal allegiance?

SIGNIFICANCE OF THE QUESTION

As a geospatial predictive analysis of AQIM activity in Algeria, the results of this research provide actionable COIN knowledge, pointing the way towards resource allocation and improved situational awareness of AQIM's geospatial patterns within the area of interest. The primary intent and significance of this body of work, however, is to offer *a lens on the transitional phases of local terror groups,*

historically motivated by regional issues, as they absorb Al-Qaeda ideology and as they are officially absorbed by Al-Qaeda.

CONTEMPORARY ISLAMIST TERRORISM IN ALGERIA

HISTORICAL GROUNDING

Origins of the GSPC

Contemporary Islamist terrorism in Algeria is rooted to the 1990s civil war which cost over 100,000 lives. The political turmoil began on June 12, 1990 when the *Front Islamique du Salut* (Islamic Salvation Front, FIS) was democratically elected in the regional and municipal elections in landslide victories against the *Front de Libération Nationale* (*National Liberation Front*, FLN), but the FIS victory was immediately rejected by the incumbent military apparatus. The Algerian army cancelled a second round of national legislative elections scheduled for January 1992 owing to another likely FIS victory. A decade-long era of terror and conflict between the Armed Islamic Group (GIA), the new armed wing of FIS, and the secular Algerian military ensued. During this period, the GIA launched brutal tactics, including the indiscriminate massacre of women, men, intellectuals, children, and the elderly, sometimes culminating in the destruction of entire villages. Popular resentment to the GIA's tactics emerged and a splinter group, the Salafist Group for Preaching and Combat (GSPC), was formed in 1998. Led by Hassan Hattab, the GSPC disavowed violent attacks on non-military targets. The GSPC's motives remained predominantly regional: its targets were the North African "colonial" presence of Europe (especially France) and the United States, along with the North African regimes that lent the former colonial support. However, the GSPC's locally focused terror activity against neo-colonial elements quickly parlayed into Al-Qaeda's global ideologies—jihad against the West. The GSPC officially became Al-Qaeda in the Islamic Maghreb (AQIM) in September 2006, constituting a key part of renewed violence in the 21st century Maghreb.

Emergence of Al-Qaeda in the Islamic Maghreb

Despite an amnesty program in the late 1990s, which led many of the former GIA militants to lay down their arms, the GSPC nonetheless continued to gain power and influence in Algeria. In 2003, a splinter faction of the GSPC, El Para, kidnapped 32 tourists, including fifteen Germans from the Sahara, later exchanging them for a five million euro ransom. The kidnappings launched the GSPC onto the world stage, both garnering the notice of intelligence agencies worldwide and providing a monetary foundation upon which to expand the group's activities. Despite speculations that Osama bin Laden and Al-Qaeda network provided early funding for the GIA and was involved in the GSPC's formation, the GSPC did not declare any sort of allegiance to Al-Qaeda until October 2003. The group's then leader, Nabil Sahrui, issued a communiqué asserting that the GSPC was operating at the behest of and in full accordance with bin Laden and Taliban leader Omar Mullah. The allegiance may have been due to a desire for broader, global objectives (e.g. jihad within the West, the establishment of an Islamic caliphate) and the experience of some GSPC founding members in Al-Qaeda's Afghan training camps. The GSPC's intent to align with Al-Qaeda would not be formalized by Al-Qaeda for another three years.

On September 11, 2006, Al-Qaeda lieutenant al-Zawahiri approved the GSPC merger with Al-Qaeda. This marked a shift from a regional insurgency, similar to the GIA, into a global struggle with a regional North African dimension, aimed at overthrowing apostate regimes and establishing Islamic caliphates on the model of the Prophet and the four "rightly guided" caliphs. It wasn't until late January/February 2007 the group actually changed its name from the GSPC to Al-Qaeda Organization in the Islamic Maghreb, after gaining the approval of Osama bin Laden and following six near-simultaneous attacks of police stations in towns east of Algiers.

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The aforementioned 2003 kidnapping provided valuable funding to reinvigorate the Algerian jihad, providing for the purchase of surface-to-air missiles (SAMs), heavy machine guns, mortars, and satellite-positioning equipment. With a revitalized ideology and renewed resources, AQIM was able to begin a major escalation in its terror campaign. Eschewing its former claims to discriminate targeting, AQIM began to perpetrate Al-Qaeda style suicide bombings in urban environments, including suicide car bombings such as the 2007 attack on the United Nations offices in Algiers. This evidenced a transformation from a local group that lacked money, weapons, and recruits into a powerful insurgency with global connections and international aspirations.

While AQIM has continued its attacks on Algeria's security forces, the shift from a nationalist struggle to pan-Islamist issues brings highly complex geospatial distributions, patterns, and associations. For example, in the summer of 2009, AQIM vowed to attack Chinese workers in the Maghreb as an act of retaliation for Beijing's treatment of Muslim Uighurs. A convey of Chinese engineers working on a motorway project and their Algerian guards were attacked, leaving 24 paramilitary forces dead and threatening a 5.67 billion dollar Algerian-Chinese venture to build 52km of roads in Algeria (Macartney 2009). Zones under threat since the GSPC's alignment with Al-Qaeda include spaces associated with national government or Western entities, including infrastructure projects and the hydrocarbons sector, national police, tourism, and any life, intellectual, or physical space that lends collaboration with an anti-Muslim agenda. In addition, both GSPC and AQIM's territory of operation has largely been staged from the mountains of Kabylie in northern Algeria and more recently, the periphery of the Sahara, including Mauritania and Mali's trans-Sahel. As both zones are tribal in nature—belonging to the Kabylie Berbers and Tuareg respectively, and who have long been engaged in their own struggle with the Algerian government—their inclusion, to varying degrees, in the GSPC and AQIM theater of operations (both training and tactical operations), complicates our understanding of their dynamic with the already vast terrain claimed by AQIM. AQIM (and the GSPC)'s multiple concepts of space and the dynamism and depth of their terror incidents across North Africa cannot be captured in this brief analysis based strictly on Open Source data. Nonetheless, this geospatial modeling offers an initial approach to factors that align with or deter GSPC/AQIM terror activity in northern Algeria. The factors which were available through open sources and which were selected for this research are further described in methodology.

GEOSPATIAL GROUNDING

The above history allows us to advance our awareness of the geospatial framework of AQIM and its Algerian predecessor, the GSPC. For this inductive analysis of AQIM's signature, validation points were culled from NCTC WITS for all incidents in Algeria attributed to AQIM. However, as the historical grounding suggests, intelligence analysts have pointed to GSPC-Al-Qaeda interconnectivity long before al-Zawahiri's official confirmation of the GSPC's allegiance in 2006 and Bin Laden's approval of an AQIM entity in early 2007. Accordingly, event data for this analysis has been collected from two time periods, pre-AQIM and post-AQIM, using the al-Zawahiri announcement as the official date of the GSPC merger with Al-Qaeda. As WITS data only documents Algeria's terrorist incidents back to 2004, validation points were only used for the available time period. Likewise, a signature for the GSPC, pre-alignment with Al-Qaeda (that is, before October 2003), could not be captured from this particular data source.

Various spaces—life, physical, and intellectual—were evaluated as possible geospatial contributors to AQIM's theater of operations. Life space is 'cognition *in* space' and our actions that we perform relative to ourselves (Bacastow and Bellafiore 2008-2010). For instance, areas with dense tree cover, high populations of single men, or foreign investment may be suitable for the Al-Qaeda life cycle of covert training, recruitment, and financing, respectively. Meanwhile, physical space is cognition *about* space, the nature, structure, and function of phenomena—for example, land cover classes, slope, and the

hierarchy of roads and trails in Algeria. Finally, intellectual space is considered cognition *with* space—associations that might be held with the tribal territory of Kabylie, critical infrastructure or key resources bearing symbolic associations to the national government or federal government. Consideration of these three types of spaces guided the data foraging process and were used to formulate the factor data inputs and analyze the factor metric outputs of Signature Analyst.

THEORETICAL BACKGROUND

The project workflow was theoretically guided by principles inherent to predictive geospatial analytics. Predictive geospatial modeling is rooted in the notion that modeled events are neither uniform nor random in distribution—in the case of this research, it is spatial factors that constrain and influence where the locations of GSPC and AQIM events occur and the events are *inductively* analyzed through their correlation with the limits and constraints posed by these geographic filters. The inductive method and empirical approach are crucial in that both known and *unknown* correlations between factors and events are discovered, thus overcoming potential preconceptions of the analyst.

At the same time, both the analytical inputs and outputs of Signature Analyst demand foraging and sensemaking strategies and the entire empirical process demands a fair amount of human judgment. This is why SGAM proves a useful complement in directing the SA process, and may even serve as the methodological backbone. For this analysis, Structured Geospatial Analytic Methods (SGAM) proved critical in creating, refining, and making sense of the question, models, and outputs. Discovery of spatial patterns and rendering meaningful and actionable information from those patterns is a tradecraft of both art and science. It involves both the empirical, systematic scientific methods behind a software like Signature Analyst, as well as effortful human cognition that includes non-quantitative methods and subjective, intuitive judgment. In this regard, SGAM is a useful mechanism in that, like Signature Analyst, it moves us beyond our limitations, our biases and blind spots. When used together in a workflow, a powerful geospatial software and a structured, rigorous method of geospatial analysis can decrease the likelihood of analyst failings and produce more potent, objective, and accurate intelligence.

METHODOLOGY

QUESTION

The analytic question was initially defined as a broad interest in the nature of AQIM activity in Algeria and how absorption into Al-Qaeda might alter the tactical theater of regional terrorist organizations like the GSPC. The question was refined as raw data was collected and the availability of Open Source information and time constraints delimited the extent of the question addressed. The ultimate question pursued was: did the GSPC significantly alter its theater of operations as it was absorbed by Al-Qaeda? As a GEOINT professional, other technological and methodological questions guided the overall workflow. These were: a desire to explore SPADAC's Signature Analyst (SA) geospatial suite and a desire to know how, when, and if Bacastow and Bellafiore's Structured Geospatial Analytic Methods could and should be deployed in tandem with the methods of empirical, inductive geospatial predictive modeling.

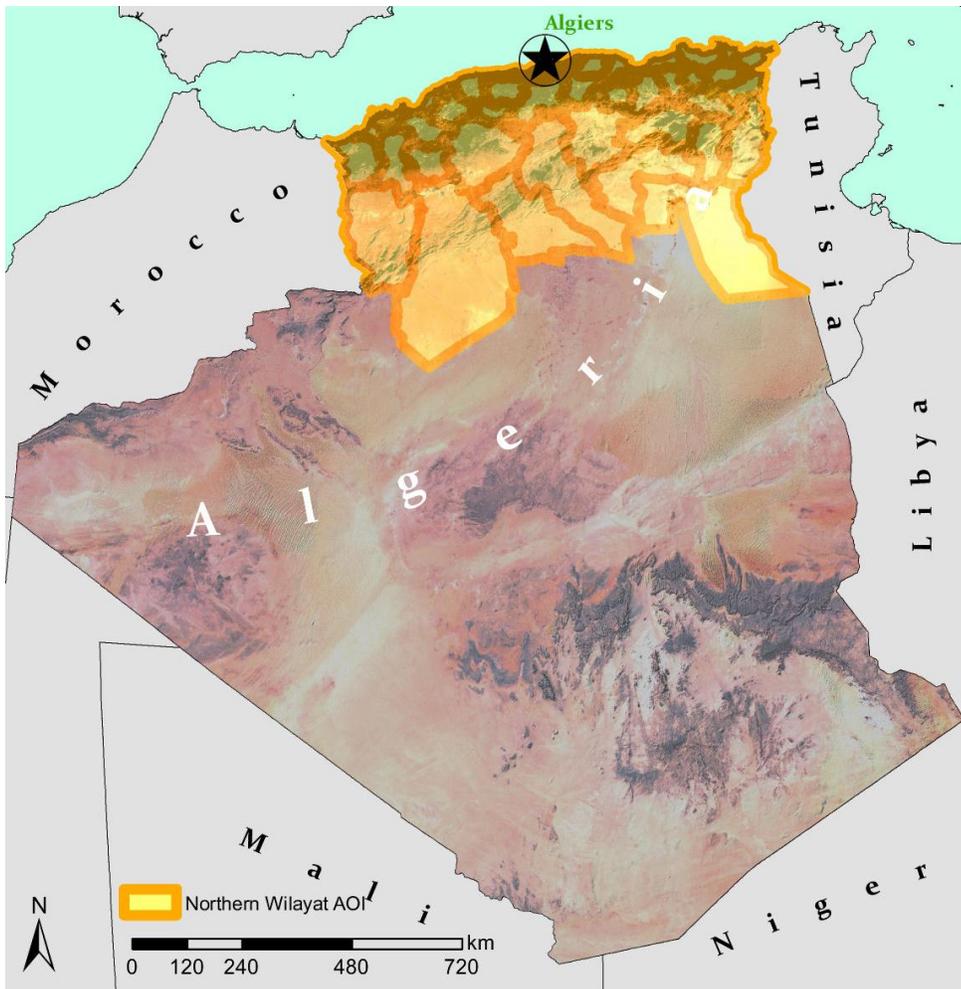
GROUNDING

The data collection process was driven by the problem to be solved, including the analytical question, and geospatial information requirements needed to adequately run Signature Analyst. Raw data for was culled from Open Source resources, including GIS data portals like CGIAR-CSI and GIS Data Depot, research organizations, scholarly publications, and government sites including the U.S. National Counterterrorism Center, Algeria's Office Nationale des Statistiques and Ministère de l'Energie et des Mines, as well as Volunteered Geographic Information sites like OpenStreetMap. Sources for specific data components and pertinent metadata are detailed in the bibliography.

The potential repertoire of geospatial data was collected, developed, and accumulated from vector, raster, and textual/numeric sources that could subsequently be converted into geospatial layers. Geospatial data was strategically sought to satisfy SA's inputs of Events, Area of Interest, and Factors.

Event data was collected from the earliest available date to the most current available information. All events documented as suspected or confirmed GSPC or AQIM by WITS for the timeframe of analysis concerned were included in the raw Event list. Subsequent filtering of the event dataset will be further discussed in methodology and concerns about coarseness and ambiguity will later be described in the caveats section.

The Area of Interest (AOI) was likewise adjusted and refined as validation points for the analysis were pulled from the initial raw Event list. The northern *wilayat* (administrative subdivisions) of Algeria, where AQIM and GSPC terrorist incidents have predominated, were selected for the first AOI assessment [Fig. 1]. The *wilayat* of the AOI included 41 of Algeria's total 48 administrative divisions. Those excluded were: Tindouf, Bechar, Adrar, Tamanghasset, Illizi, Ouargla and Ghardaia. The AOI was then again expanded to the entirety of Algeria for a second assessment to see if this might bring additional dimensions to the analysis.



[Fig 1] Refined AOI, Northern wilayat (provinces) of Algeria

Factor data collected for this research included physical, intellectual, and life spaces, as already described. An emphasis was placed on geospatial characteristics and values, including locations, regions, hierarchies, networks, surfaces, and spatial distributions.

HYPOTHESIS DEVELOPMENT

In response to the initial question—*What patterns engender the GSPC’s political realignment as a new Al-Qaeda affiliate (AQIM) and their theater of operations after September 11, 2006?*—all reasonably possible and available geospatial patterns that might empirically align with the events as deterrents or attractors for terrorist incidents perpetrated by the GSPC/AQIM were explored and readied for evidence development. As SA discovers both known and *unknown* patterns, hypotheses about the relationship between validation points (Events) and Factors and their implications for the analytic question are inherently developed and refined through iterations of the SA assessment. Multiple builds of the model,

with adjustments to Event, Factor and AOI inputs, proved to reveal nuances and led to further data foraging, exploitation and analysis. As will be described in Results, the answer to the question is largely discovered and sharpened through both empirical Factor Metric outputs, such as Likelihood and Contrast Measure, as well scrutiny and interpretation of the Factor Metric curves.

EVIDENCE DEVELOPMENT

Raw information for each factor—statistical data, elevation data, point and line data, anthropological maps of Kabylie, etc.— was next converted into shapefile or raster form usable for SA processing and analysis. All files were reprojected to UTM 31N, as Algeria spans UTM multiple UTM zones but is centered on zone 31. The following further discusses development and preparation of AOI, Events, and Factors for Assessment.

Area of Interest

For SA, the AOI defines the area the assessment describes and the level of detail. The AOI resolution was adjusted to a resolution appropriate for the level of coarseness afforded by the Factor data. For the Northern *wilayat*, the AOI was adjusted from a cell resolution size of 10.4875 km to 1km, or from a cell count of 6900 to 750,035. While the finer resolution of the SRTM data (at 90m resolution), meant that the AOI cell size could have been made even smaller (i.e. 100m cell size for a total cell count of 74,926,272), the typical sociocultural Factor data (i.e. masculinity index) was at the district level. A finer resolution than 1k would have implied more geospatial accuracy for the Assessment than was available from the Open Source Data.

Events

The quantity and quality of WITS data were next addressed. WITS documentation of GSPC and AQIM incidents is less-than-perfect in terms of accuracy. Specific coordinates of attacks are not listed. Only the town or city most proximate to the attack and, sometimes, only the district is listed. Ambiguity also arises from the fact that cities, districts, and *wilayat* (provinces) often have the same name in Algeria, such as the city of Constantine in Constantine district in the Constantine province. Additionally, a large number of incidents were documented for each terrorist organization for the time frame under consideration—66 and 126 for the GSP and AQIM, respectively, are documented by WITS from 2/10/2004 to 7/5/2010 [See Fig. 2 for WITS Events document in the northern *wilayat* AOI]. SA best practice literature advise reducing Events to the most homogeneous and accurate occurrences. 15-30 Events are considered a typical number for SA, with more Events creating more uncertainty in the signature. Limiting the Events to the most accurate and homogeneous data was therefore the next critical phase of evidence development and to obtaining meaningful outputs from SA. Narrowing the Events (validation points) is where significant human judgment steps in. The following describes my own systematic and informed approach to narrowing the validation points prior to undertaking SA Assessment.

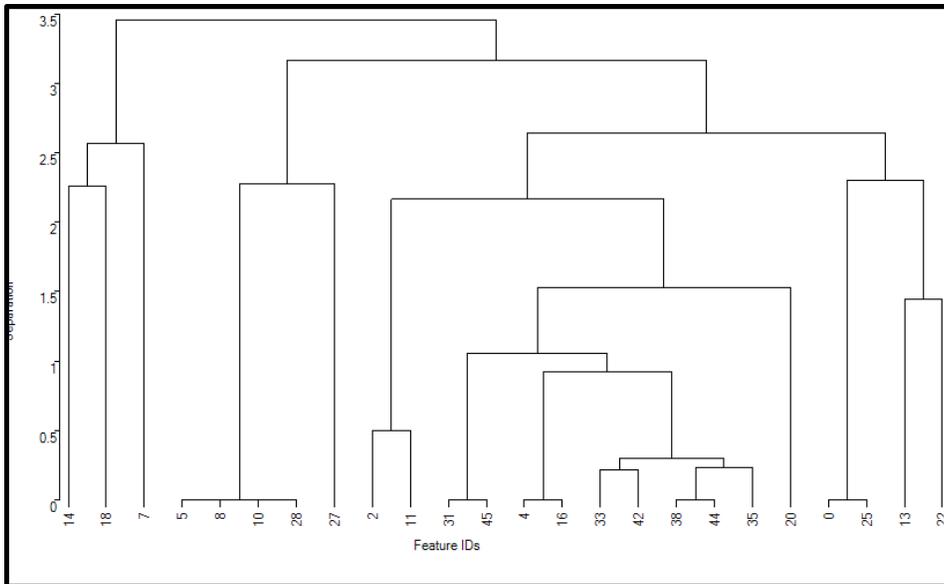
All Events were first matched to coordinates provided by the World Place Name Gazetteer. Events listed in WITS that only had district attributes, rather than the more descriptive town or city attributes were removed, along with Events occurring in towns that were not listed in the World Place Name Gazetteer. Additionally, incidents with ambiguity as to whether the locational attributes referred to the city or province location were eliminated (For example, unless WITS specified “Boumerdès, Boumerdès” it was assumed that anything attributed only to “Boumerdès” referred to the district not the city proper. While all GSPC events were documented as ‘suspected’, AQIM events were recorded in WITS as either ‘suspected’ or ‘confirmed’. For AQIM events, all ‘suspected’ incidents were removed from the validation set. A final list of approximately 50 Events for both GSPC and AQIM still remained at this point in the

Deputy mayor killed in armed attack by suspected GSPC in Aomar, Bouira, Algeria	20	6/4/2005
1 police officer killed, 5 others wounded in bomb attack by suspected GSPC near Azeffoun, Tizi Ouzou, Algeria	22	6/23/2005
7 soldiers, 1 contractor killed, 4 soldiers wounded in armed and IED attack by suspected GSPC near Jijel, Jijel, Algeria	25	9/22/2005
3 civilians killed, 2 others wounded in armed attack by suspected GSPC in El Milia, Jijel, Algeria	27	10/6/2005
1 civilian kidnapped by suspected GSPC in Algiers, Alger, Algeria	28	12/1/2005
1 civilian kidnapped at roadblock by suspected GSPC near Beni Amrane, Boumerdes, Algeria	31	1/23/2006
1 civilian kidnapped by suspected GSPC in Chabet el Ameur, Tizi Ouzou, Algeria	33	2/13/2006
1 militia member killed in armed attack by suspected GSPC in Zemmouri, Boumerdes, Algeria	35	2/23/2006
1 civilian wounded in armed attack by suspected GSPC in Bordj Menaiel, Boumerdes, Algeria	38	4/6/2006
2 municipal guards killed, 1 other guard, 6 civilians wounded in IED attack by suspected GSPC in Tidjelabine, Boumerdes, Algeria	42	7/6/2006
1 government official wounded in armed attack by suspected GSPC in Bordj Menaiel, Boumerdes, Algeria	44	8/4/2006
ANP and BMPJ thwart incursion by suspected GSPC in Beni Amrane, Boumerdes, Algeria	45	8/19/2006

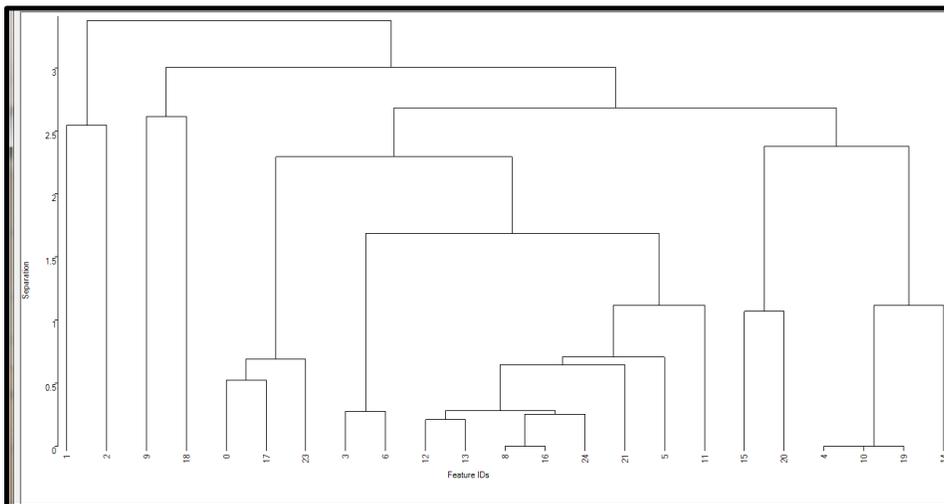
[Fig. 3] Final GSPC Validation Points (Events)

Description	Feature ID	Date
4 police officers killed, 5 others wounded in IED and armed attack by AQIM near Adekar Kebouche, Bejaia, Algeria	0	9/2/2006
1 civilian killed, 9 others wounded in IED and armed attack by AQIM in La Trappe, Alger, Algeria	1	12/10/2006
1 police officer killed, 2 other people wounded in IED attack by AQIM in Constantine, Constantine, Algeria	2	5/16/2007
1 police officer killed by AQIM in Aomar, Tizi Ouzou, Algeria	3	7/3/2007
1 police officer killed, 1 other wounded in IED attack by AQIM in Tizirt, Tizi Ouzou, Algeria	4	7/11/2007
27 sailors, 3 civilians killed, 57 sailors, 3 civilians wounded in suicide VBIED attack by AQIM in Dellys, Boumerdes, Algeria	5	9/8/2007
5 gendarmes, 4 civilians wounded in suicide VBIED attack by AQIM in Lakhdaria, Bouira, Algeria	6	9/21/2007
4 police officers killed, 12 civilians, and 8 police officers wounded in suicide VBIED attack by AQIM in Naciria, Tizi Ouzou, Algeria	8	1/2/2008
8 police officers killed in armed attack by AQIM in El Oued, El Oued, Algeria	9	2/8/2008
1 police officer killed in armed attack by AQIM in Tizirt, Tizi Ouzou, Algeria	10	4/5/2008
2 civilians killed in IED attack by AQIM in Beni Amrane, Boumerdes, Algeria	11	6/8/2008
8 civilians killed, 11 others, 6 police officers wounded in suicide VBIED attack by AQIM in Zemmouri, Boumerdes, Algeria	12	8/9/2008
42 civilians, 1 police officer killed, 32 civilians, 13 police officers wounded in suicide VBIED attack by AQIM in Les Issers, Boumerdes, Algeria	13	8/19/2008
4 police officers wounded in IED attack by AQIM in Azazga, Tizi Ouzou, Algeria	14	9/14/2008
9 security guards killed, 3 others wounded in IED and mortar attack by AQIM in Ziama Mansouria, Jijel, Algeria	15	2/22/2009
2 paramilitary members, 1 civilian wounded in IED attack by AQIM near Naciria, Tizi Ouzou, Algeria	16	5/5/2009
8 police officers, 2 educators killed, 1 educator, 1 civilian wounded in assault, IED, and armed attack by AQIM near Timezrit Il Matten, Boumerdes, Algeria	17	6/2/2009
1 paramilitary member, 1 civilian wounded in IED attack by AQIM in Taxlent, Batna, Algeria	18	7/5/2009
1 police officer killed, 2 others wounded in IED attack by AQIM in Tizirt, Tizi Ouzou, Algeria	19	8/15/2009
2 soldiers, 1 security guard, 1 civilian killed in IED attack by AQIM in Emir Abdelkader, Jijel, Algeria	20	8/27/2009
1 civilian killed in armed attack by AQIM in Si Mustapha, Boumerdes, Algeria	21	9/13/2009
7 security guards, 1 soldier killed, 2 soldiers wounded in double IED attack by AQIM near Tifra, Bejaia, Algeria	23	4/3/2010
1 civilian killed, 10 civilians, 5 police officers, 6 soldiers, 1 government official wounded in double IED attack by AQIM in Baghliia, Boumerdes, Algeria	24	5/13/2010

[Fig. 4] Final AQIM Validation Points (Events)



[Fig. 5] GSPC Dendrogram: Final Event selection



[Fig. 6] AQIM Dendrogram: Final Event selection

Factors

The physical, life and intellectual spaces investigated and included in the Assessment Factors fall into five major categories: terrain, points of interest, critical resources and infrastructure, demographics, and sociocultural attributes. As the intent of SA is to discover both known and unknown relationships between geospatial qualities and historical incidents, and to find both attractors and repellents for Event emergence, as much factor data as could be collected and that bore anticipated, as well as unknown or

unconsidered, positive or negative correlation to terrorist activity in Algeria was used for the Assessment. Terrain data used for Factor Metrics of the Events included incidence by land cover type (according to Africa's Global Land Cover Characterization Database), slope (as derived from 90m SRTM data), and by tribal region (first using the linguistic region of Kabylie, based on where Kabyle is spoken, as documented by André Basset, *Atlas Linguistique des Parlers Berbères: Algérie - Territoires du Nord*, Université d'Alger, Institut des Etudes Orientales 1936. A second version of the political boundaries of Kabylie, as defined by the Mouvement pour l'Autonomie de la Kabylie (MAK), was also used for a comparative assessment of probability density of GSPC and AQIM Events with Kabylie. Further discussion of the Kabylie terrain and its implications for AQIM activity is offered in Results and Questions/Caveats). Points of Interest included police stations, places of worships, lodging, and schools, as documented in Open Street Map. Critical Infrastructure considered in the Assessment included proximity to highways, roads, trails, utility lines, mining sites, pipelines, and airports. Demographic data included gender (percent female, percent male, national masculinity index), population density (persons per km²) and population growth as documented by the National Census of Algeria. Sociocultural data considered includes illiteracy rates and education indices (% with primary, secondary, upper level education, or no education), indices for marriage, divorce, and single populations. Commerce data was also explored in the Assessment, including percentage of import and export, industrial, retail, service, and wholesale commerce. All statistical data gathered for demographic and sociocultural attributes was accessible and seamless in coverage at the provincial level for the refined AOI of the northern *wilayat* as well as for the entirety of Algeria. After data preparation of the Factors was complete, Factor Type Functions (FTFs) were selected for each Factor (Nearest Neighbor Distance, Nearest Neighbor Value, Nearest Neighbor Category) according to the type of geospatial data represented by the Factor. Once the data inputs and their properties were created, SA was run to create the intermediate stages of Raw Factor Data (RFD) and Probability Density Function (PDF) Curves, which are based on this data. The final SA Assessment, which aggregates Assessment Layers for each Factor, was not created or analyzed until the various Factors had been individually run and their PDF curves and statistics (Factor Metrics) studied. Uninformative Factors, or those with trivial or nondistinctive information, were disabled and the model was rerun to evaluate if indeed these Factors were 'noise' and if a more accurate Assessment could be produced.

SOFTWARE

ARCgis 9.3 was the primary software for manipulating data and shapefiles. Both Signature Analyst GUI 3.2 and the ArcGIS Signature Analyst 3.2.1 extension were used in the initial phases of exploring the data. Final outputs were created in the Signature Analyst ArcGIS extension. The basic nature and capabilities of Signature Analyst has been described elsewhere in this report.

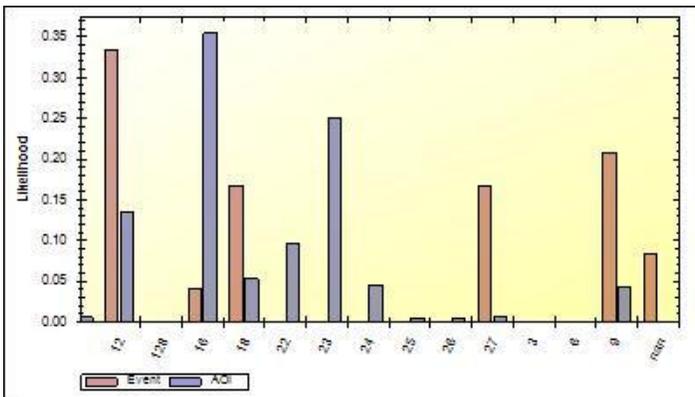
RESULTS

Results were interpreted by reading Probability Density Function (PDF) Curves and Factor Metrics, which describe the relationship of Events and the AOI to a Factor. The PDF curves are essentially continuous histograms which visually describe these relationships while Factor Metrics are statistics that describe the impact of specific Factors on Assessments produced in Signature Analyst. Overall, certain Factors corroborated expectations—police stations were high attractors, for example -- while some provided little insight (uninformative Factors, or those with low Contrast Measure), and others revealed themselves as surprising repellors or attractors that describe the nuanced geospatial signatures of historic GSPC and AQIM attacks. Factor Metric PDFs also revealed key quantitative and categorical details, such as specific population densities or land cover types for which attacks are most likely to emerge. For most Factors, GSPC and AQIM events exhibited surprisingly similar PDF curves and Factor Metrics. What divergences did appear are detailed below in the results summary below. The PDF and

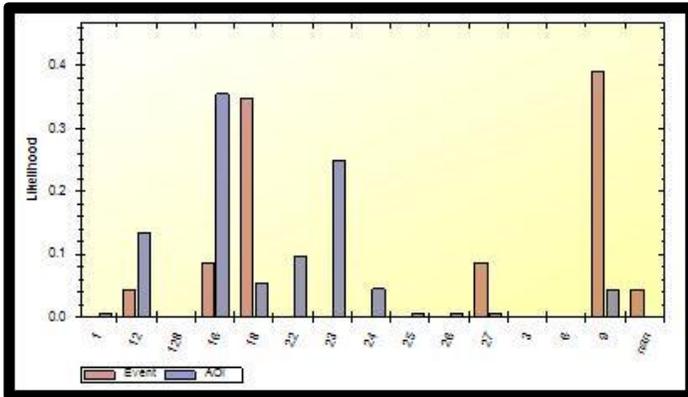
Factor Metric analysis presented below represents a close study of Probability Density Function Curves (PDF) for the Event (shown in the figures below in red) and for the AOI (shown in the figures below in blue). Both highest scoring Likelihood, as expressed in units of probability density (i.e. probability/area), and the Contrast Measure (difference in overlap) of the Event and AOI PDFs curves were examined in order to report highest contributing Factors to the GSPC and AQIM Signature Analyst Assessment and to eliminate uninformative Factors.

Terrain: Physical and Cultural

In the images below, the blue bar charts the likelihood for the AOI to be a certain land cover type. For instance, we see below that sparse grassland (16) predominates with a .35 Likelihood value. The red bars represent GSPC and AQIM Events for Figures 7 and 8, respectively. So, for sparse grassland, a GSPC Event has a .03 Likelihood Value while an AQIM Event has a value of .09. This suggests that sparse grassland is a deterrent for both groups, but that the probability density of an AQIM incidents is 3 times greater in sparse grassland that GSPC events. With respect to physical terrain, GSPC Events demonstrated a higher Likelihood value than the AOI for type 12 (open deciduous shrubland), 18 (terrain with greater than 50% cropland), 27 (cities) and 9 (closed deciduous forest) while 16 (sparse grassland) had much lower Likelihood values for the Event PDF than the AOI PDF. This means that while sparse grassland is a repellent for GSPC incidents, open deciduous shrubland, cropland, cities, and closed deciduous forest are attractors. AQIM presents a markedly different land cover signature: type 12 (open deciduous shrubland) is, in fact, a repellent. There exists preference for Event Likelihood in 18 (cropland, greater than 50%) and 9 (closed deciduous forest). While the Likelihood value of encountering a closed deciduous forest in the entire AOI is .06, there is a .4 Likelihood value of AQIM events will emerge there, as opposed to in other land cover types. In contrast to the GSPC, there is less Event to AOI Likelihood in cities (27) and 16 (sparse grassland) is only a moderate deterrent.



[Fig. 7] GSPC NNC Landcover

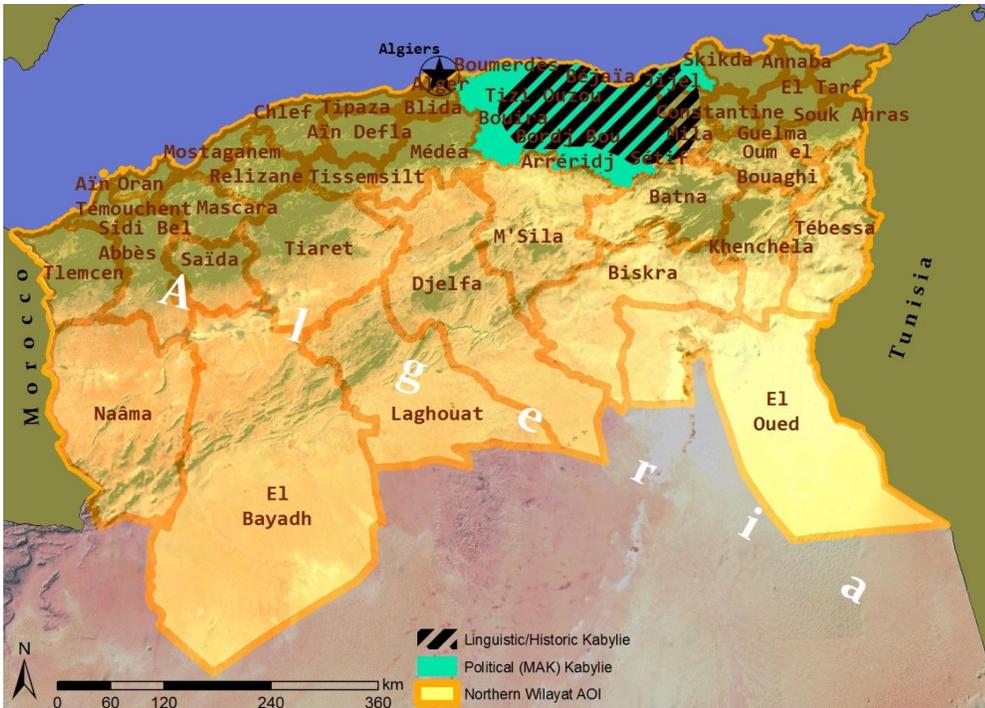


[Fig. 8] AQIM NNC Landcover

Two geographic versions of the cultural and ethnic terrain of Kabylie were created and evaluated as Nearest Category Factor Type Functions. The first version represents the historic linguistic region of Kabylie (which bears no connection to contemporary province or district lines) while the second version represents the contemporary political region defined by the MAK (Mouvement pour l'Autonomie de la Kabylie), which is comprised of Bouira, Bordj Bou Arréridj, Sétif, Jijel, Béjaïa, Tizi Ouzou and Boumerdès [See Fig. 9 and 10 for a spatial comparison of the two versions of Kabylie].



[Fig. 9] Contemporary Political Kabylie of the Mouvement pour l'Autonomie de la Kabylie (MAK).



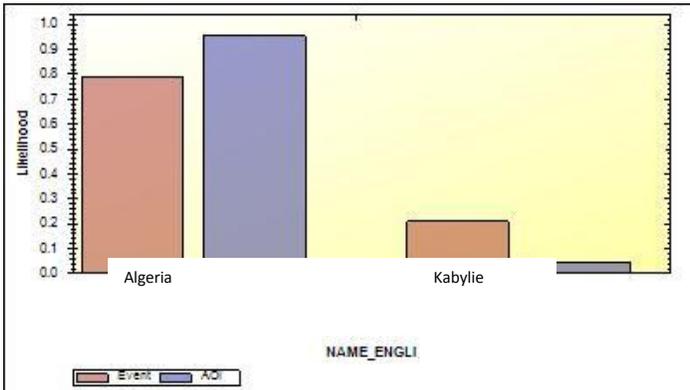
[Fig. 10] Comparison of two different geographic boundaries for Kabylie.

Figures 11 and 12 below represent AOI versus Event PDF for Non-Kabyle portions of the northern wilayat (depicted on the left) and for Kabylie, as geographically defined in historic and linguistic terms. The second pair of images [Fig. 13 and 14] represent AOI versus Event PDF for Non-Kabyle portions of the northern wilayat (depicted on the left) and for Kabylie, as defined in contemporary political terms by the MAK. Although relying on different sociocultural data, the graphics corroborate results for the significance of Kabylie as a Factor in the emergence of both GSPC and AQIM events, but with a higher likelihood of AQIM incidents occurring in Kabylie. Moreover, the increased Likelihood for Events in the MAK geographic definition of Kabylie suggests that both Kabylie as a territory, as well as the *political and ideological associations* engendered by that space make it rife for terrorist incidents.

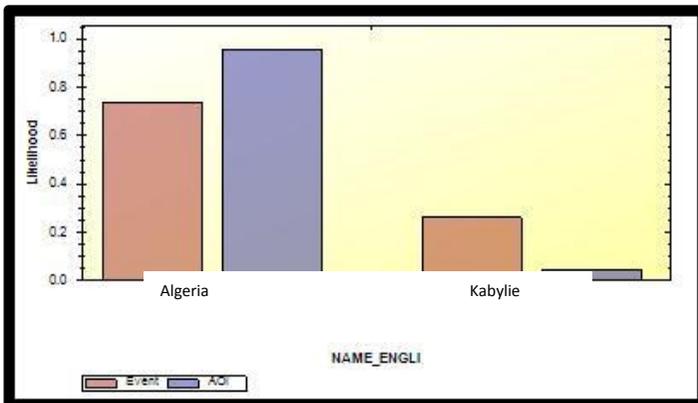
Looking to the pair of PDF curves for the GSPC and AQIM Events and their relationship to the historic, linguistic Kabylie boundary, attacks by both groups are more likely to emerge in the Kabyle zone of the northern wilayat than elsewhere. While the AOI has only a .05 Likelihood Value of occurrence in Kabylie, the GSPC Events have a .2 Likelihood Value and AQIM a .3 Likelihood for Event Occurrence in Kabylie. Figures 11 and 12 both suggest a strong Factor contribution of Kabylie to GSPC and even more to AQIM events. Kabylie here is a suggestive attractor to attacks. The reasoning behind this will be further discussed in Conclusions.

PDFs for Kabylie, as geographically defined by the political group MAK, describes an even stronger attraction between the ethnic region and AQIM and GSPC Events. While the AOI Likelihood Values remain essentially the same, the Event Likelihood Value for GSPC reaches almost .7 [Fig. 13] and AQIM

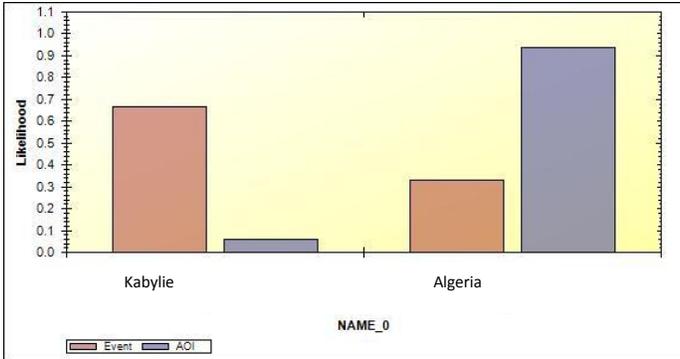
Events reach .85 [Fig. 14].Kabylie’s significance as a major attractor for Event emergence for both the GSPC and especially AQIM will be further discussed with respect to the ideology of the terrorist organizations and AQIM’s pan-Islamic jihad in Conclusions.



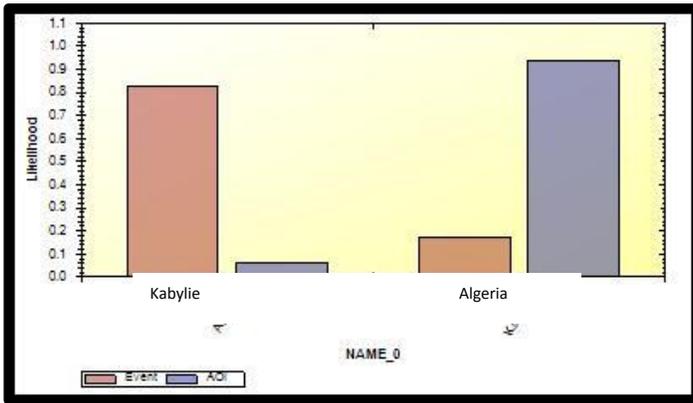
[Fig. 11] GSPC NNC Historic/Linguistic Kabylie



[Fig. 12] AQIM NNC Historic/Linguistic Kabylie

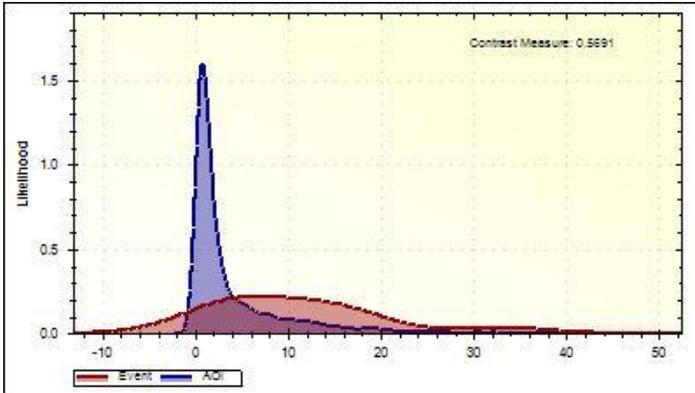


[Fig. 13] GSPC NNC MAK Contemporary Political Kabylie

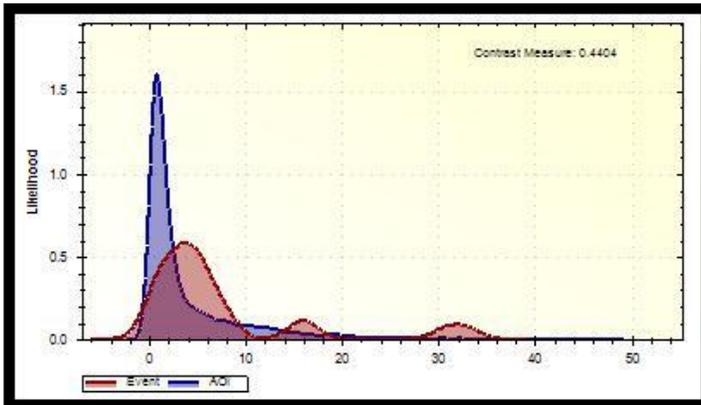


[Fig. 14] AQIM NNC MAK Contemporary Political Kabylie

Slope was the third major terrain element considered and was evaluated as a Nearest Neighbor Value Factor Type Function, where value is the degree of slope. While the PDF curve for the GSPC [Fig. 15] gently peaks its Likelihood Value at about 9° slope, the AQIM curve [Fig. 16] shows three probability density clusters, with Likelihood Values at .6 for areas with a slope of 4°, .2 for areas with a slope of 16° and .12 for areas with a 32° slope. In both cases, mean slope for the Event RFD tends is higher than for the AOI as a whole, and AQIM Events suggest a clear preference three different slope values. For both groups, high Likelihood Values for higher slope values validates the previous observation of high Likelihood Values for Closed Deciduous Forest for both terrorist group Events. Again, the Likelihood Value is higher for AQIM in this Land Cover Type and in terrain with more advanced slope, than for the GSPC.



[Fig. 15] GSPC NNV slope



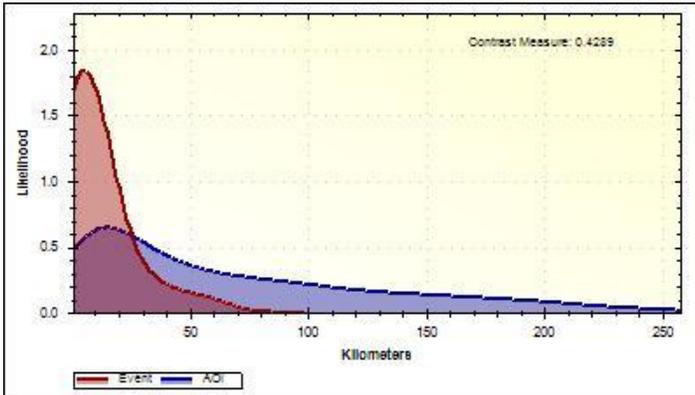
[Fig. 16] AQIM NNV slope

Critical Infrastructure.

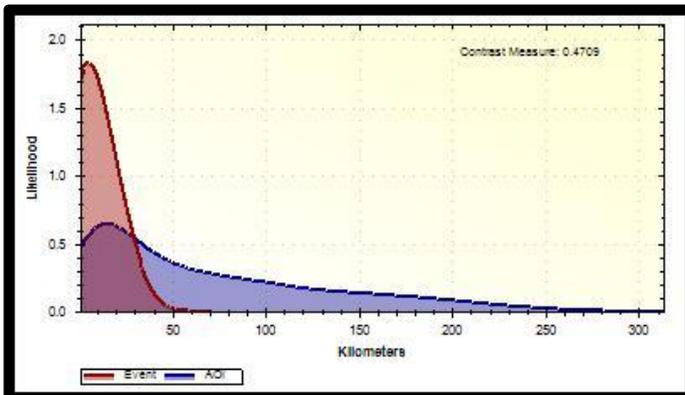
The investigation of Critical Infrastructure included hierarchies and networks of transportation features (railways, airports, trails, and roads), as well as natural resource and energy infrastructure including utility lines, pipelines for oil and gas and mining sites for fuels, metals, and nonmetals. Factors were evaluated in terms of both the overall network (i.e. NND for all utility lines) and hierarchies of status and type (i.e. NNC for utility line types or NND to each distinct type of utility line or distinct status for utility lines). Only the most informative Factor Metrics produced are represented below.

In terms of overall transportation, the network of railways proved the greatest attractor. While the Likelihood value of encountering a railway line peaked at .6 within 20km anywhere in the AOI, the Likelihood Value was 1.8 within 5 km of an Event for both the GSPC and AQIM, as shown in figures 17 and 18. Railways lines are slightly more of an attractor for AQIM. Looking to the hierarchy of the rail network in Algeria and its relationship with GSPC and AQIM Events. Further detail emerges from NNC and NND curves for each rail type. GSPC Events share a stronger likelihood with single track rails (Type 1) than AQIM Events. Although Events by both groups have relatively high Likelihood for Types 2 and 3

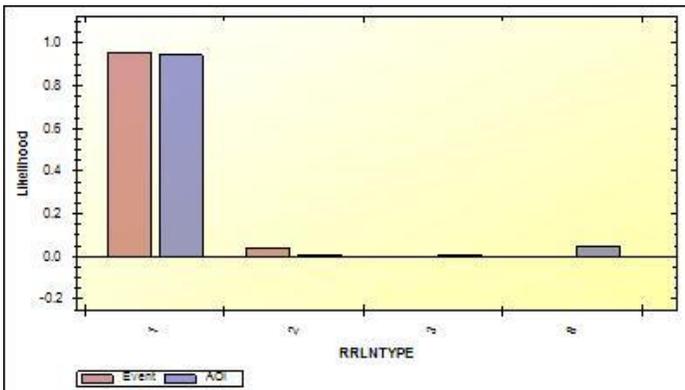
(Multi-track and light-duty), AQIM has a slightly stronger relationship with these railways types than the GSPC, as figures 19 and 20 show.



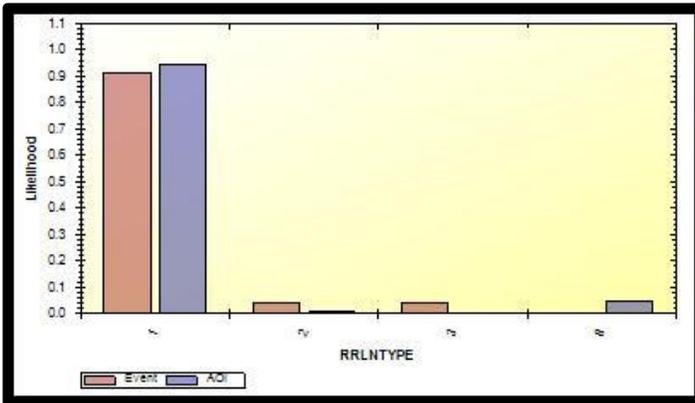
[Fig. 17] GSPC NND Rails



[Fig. 18] AQIMNND Rails

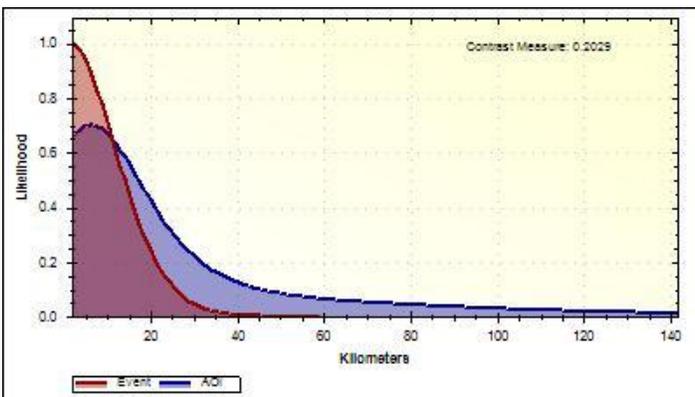


[Fig. 19] GSPC NNC Rail Types

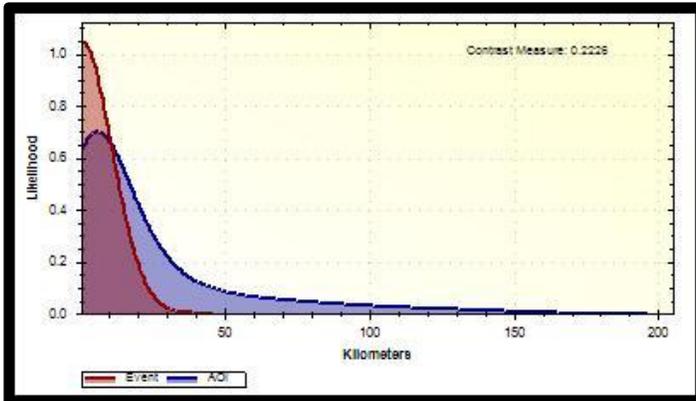


[Fig. 20] AQIM NNC Rail Types

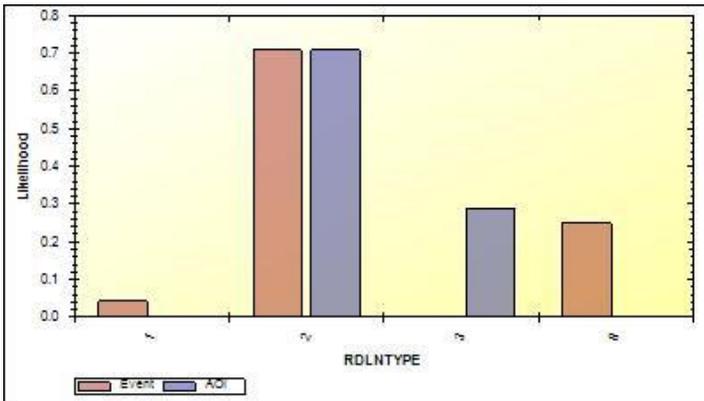
Vehicular transport networks provided the following additional information. As Figures 21 and 22 show, Factor Metrics for the general highway network (OpenStreetMap data) provided scant information and information from the Digital Chart of the World provided similarly uninformative data. Events for both groups had only moderate higher Likelihood value for occurrence than the AOI (see Figs. 21 and 22). Factor Metrics created from road type details (NNV for all types and NND for specific types) provided important information, and a comparison of Factor Metrics from OpenStreetMap Factor data and Digital Chart of the World corroborated each other. Namely, AQIM incidents had much higher Likelihood for Types 2 (Primary and secondary road) and Type 3 (Track, trail, or footpath) while trails are a mild detractor for GSPC events (See Fig. 23-25).



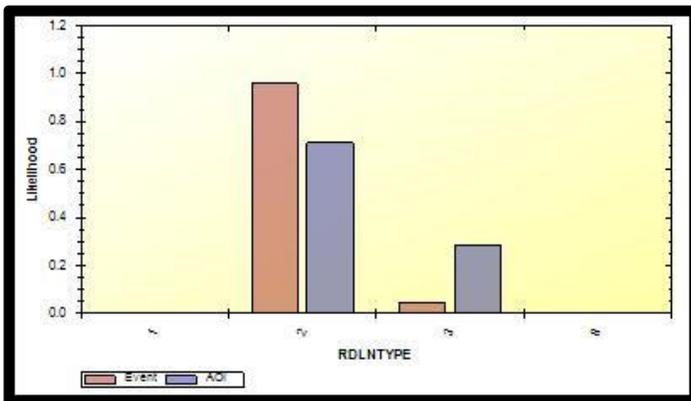
[Fig. 21] GSPC NND Highway



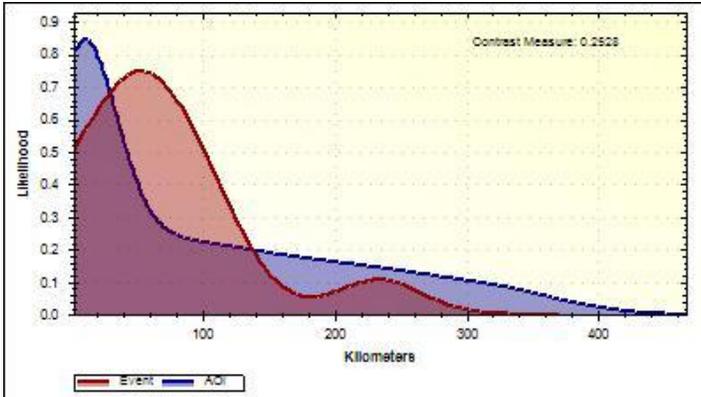
[Fig. 22] AQIM NND Highway



[Fig. 23] GSPC NNC Road Types

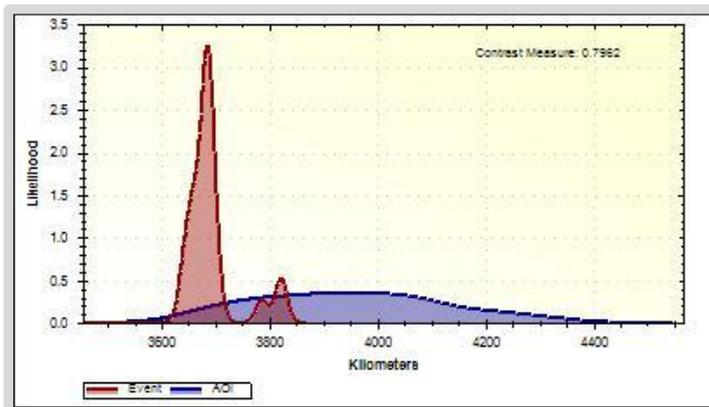


[Fig. 24] AQIM NNC Road Types

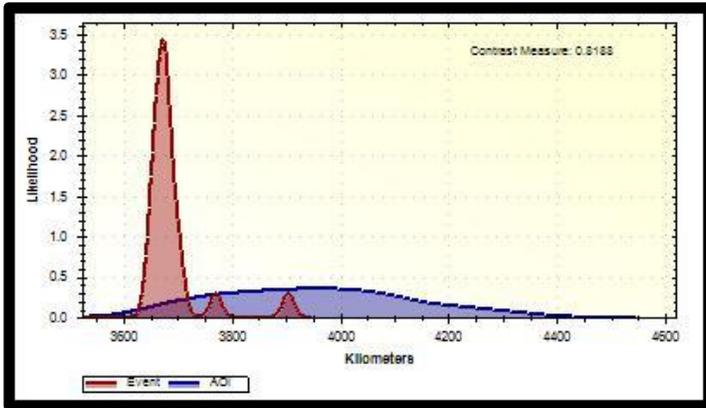


[Fig. 25] GSPC NND Road Type Trails

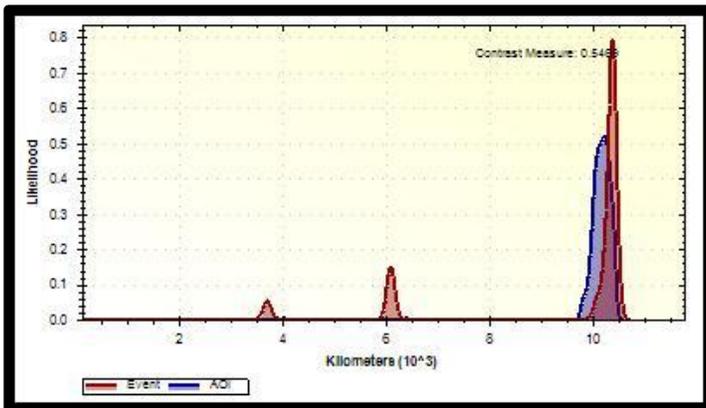
For the network of Algerian airports, both Event groups had comparable attractions [Fig. 25 and 26]. In terms of airport hierarchy, a similar pattern of significant Likelihood Values for both AQIM and GSPC Events occurred near Military Airports (Type 3). This clear read and attraction means that military airports are perhaps the most useful of airports in determining the likelihood of emergence of an event.



[Fig. 26] GSPC NND Aeronautical points GSPC

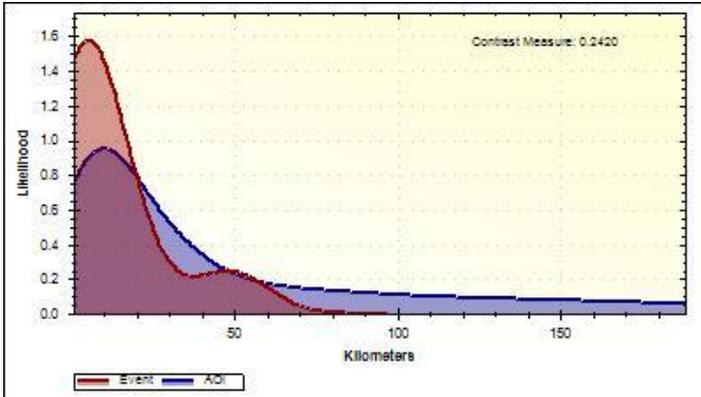


[Fig. 27] AQIM NND Aeronautical points

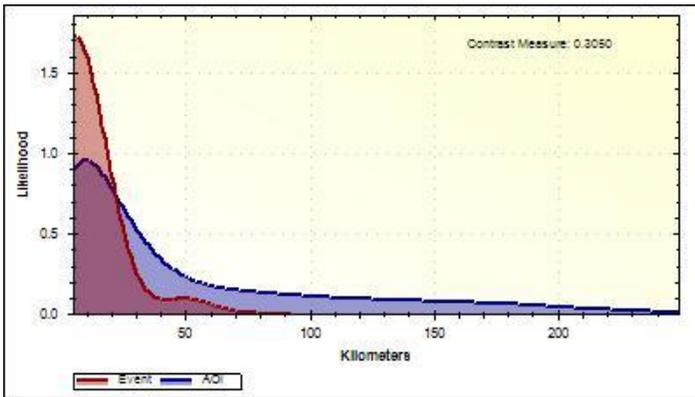


[Fig. 28] Aeronautical points AQIM: NND Military Airport (Type 3)

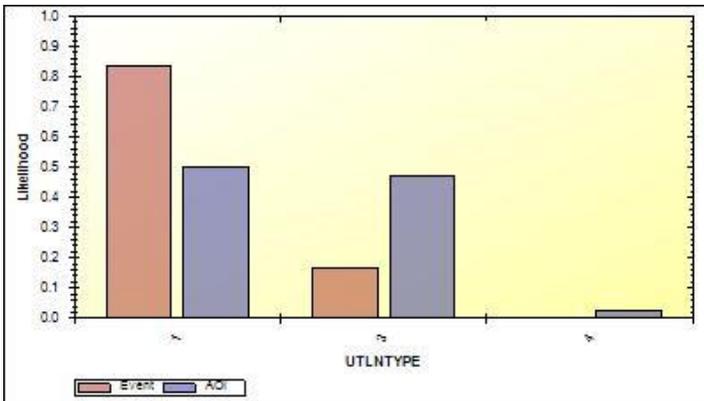
Utility networks are also an attractor, as suspected for both AQIM and GSPC Events, and both Event sets produced similar Factor Metrics [See Figs. 29-32]. For utility type Power transmission lines (Type 1) show the strongest Likelihood value and will be the best indicators among the utility lines.



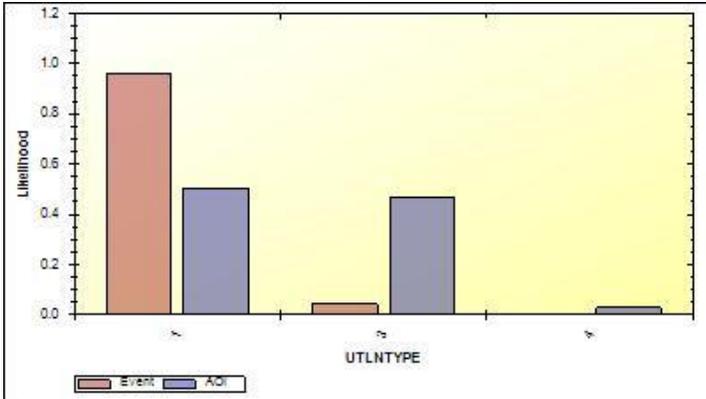
[Fig. 29] GSPC NND Utility Lines



[Fig. 30] AQIM NND Utility Lines



[Fig. 31] GSPC Utility Line Type NNC



[Fig. 32] AQIM Utility Line Type NNC

With respect to pipelines, the overall network was an attractor. Detailed Factor Metrics at the level of type and NNC reveal that oil pipelines were a strong attractor and there were comparable PDF curves and Factor Metrics for both GSPC and AQIM Events. Gas pipelines were, surprisingly, a *detractor* for AQIM Events [See Figs. 33-36 below].

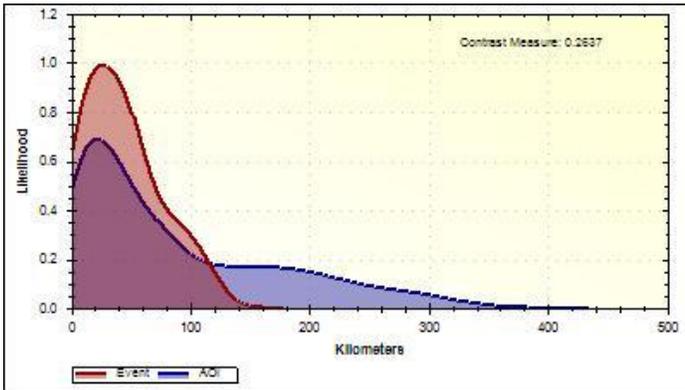


Fig. [33] GSPC NND Gas Pipeline

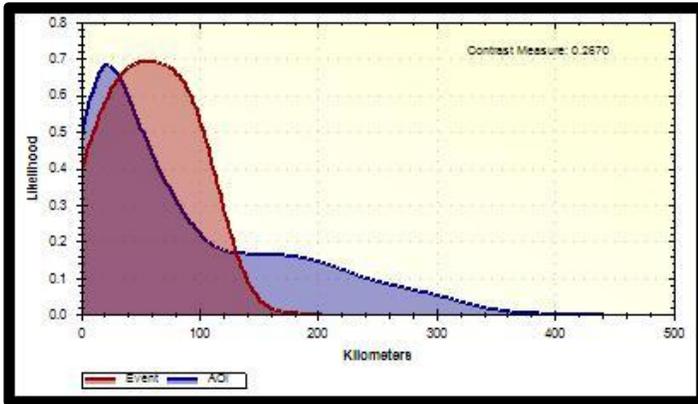


Fig. [34] AQIM NND Gas Pipeline

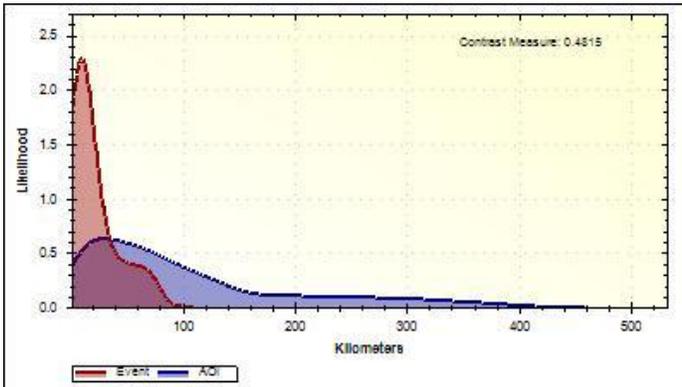


Fig. [35] GSPC NND Oil Pipeline

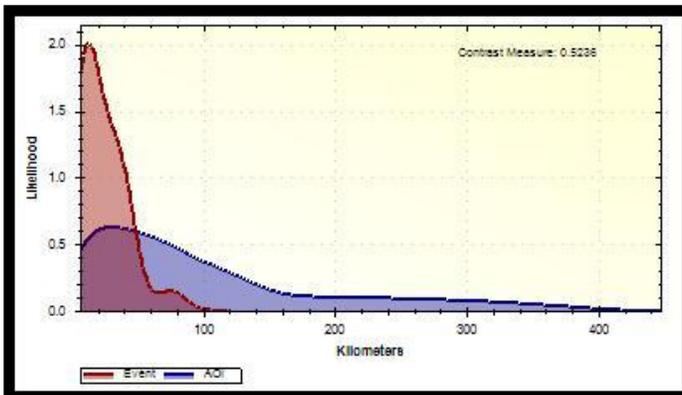


Fig. [36] AQIM NND Oil Pipeline

As Mining Sites for gas and oil extraction occurs in the southern Saharan Platform of Algeria, Factor Metrics on mining sites for analysis of the northern wilayat was most useful in terms of data on metal and nonmetal mining. When the overall network of mining sites was run, it appeared as a detractor for both AQIM and GSPC Events. However, a closer study revealed that nonmetal mining sites were strong attractors and a NND Factor Type Function PDF curve reveals a different picture of the relationship between Events and mining sites in the northern wilayat. Again, Factor Metrics for both terrorist organizations were very similar. See Figures 37-40 for the above analysis.

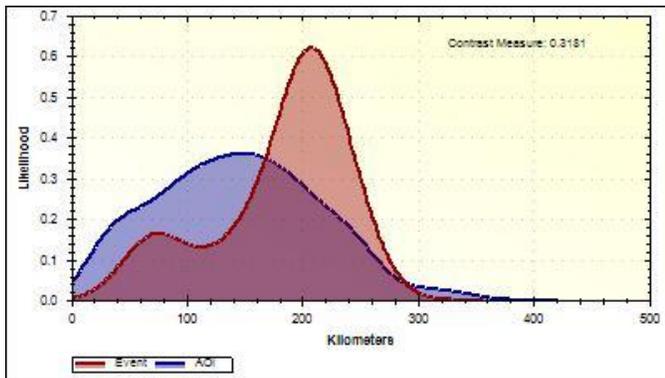


Fig. [37] GSPC NND Mining Sites

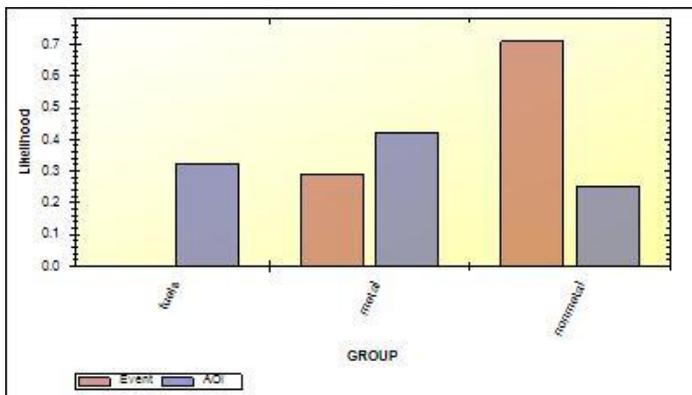


Fig. [38] GSPC NNC Mining Sites

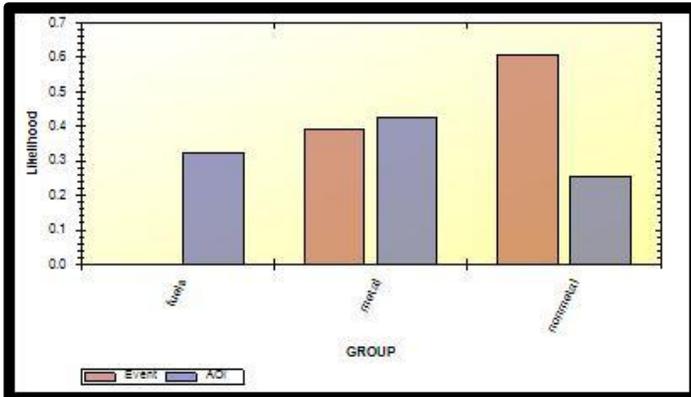


Fig. [39] AQIM NNC Mining Sites

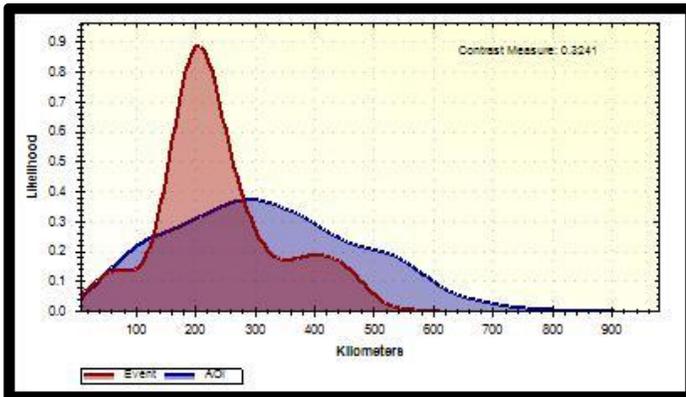


Fig. [40] AQIM NND Nonmetal Mining Sites

Points of Interest

Points of interest (POI) evaluated as Factors included lodging, police stations, places of worship and schools. Factor Metrics for both Event sets were again strikingly similar. While all POI were attractors, as expected, lodging was the most distinctive attractor for Events among the POI. {See Figs. 41-48 below}.

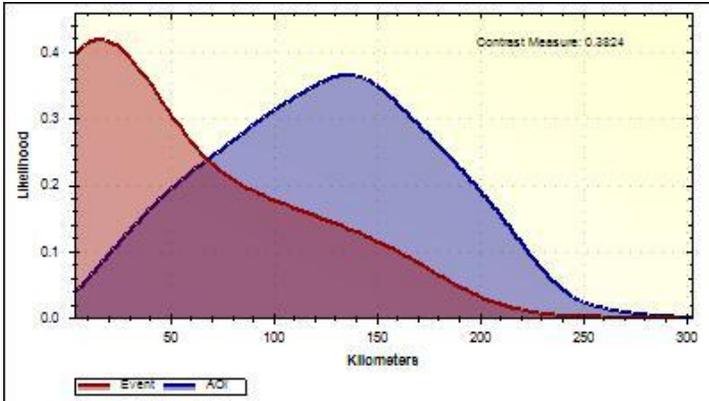


Fig. [41] GSPC NND POI Lodging

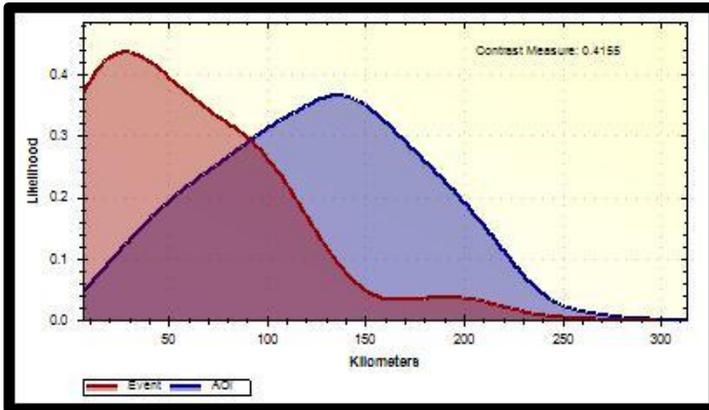


Fig. [42] AQIM NND POI Lodging

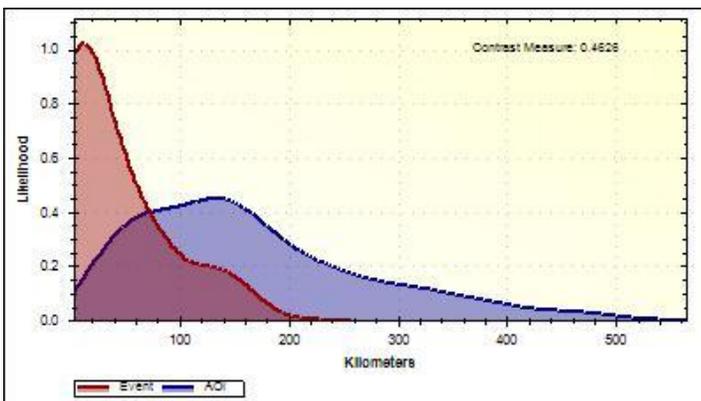


Fig. [43] GSPC NND POI Place of Worship

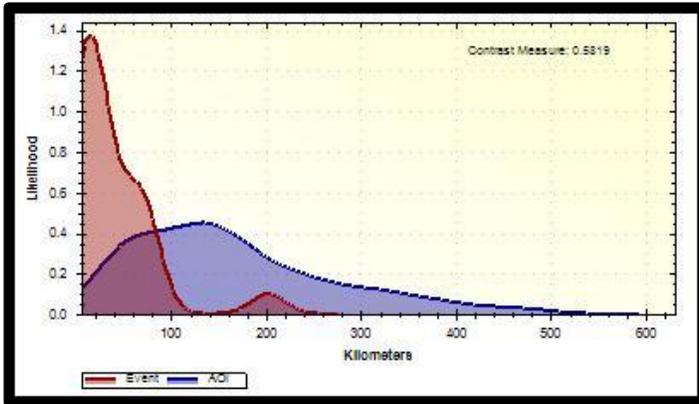


Fig. [44] AQIM NND POI Place of Worship

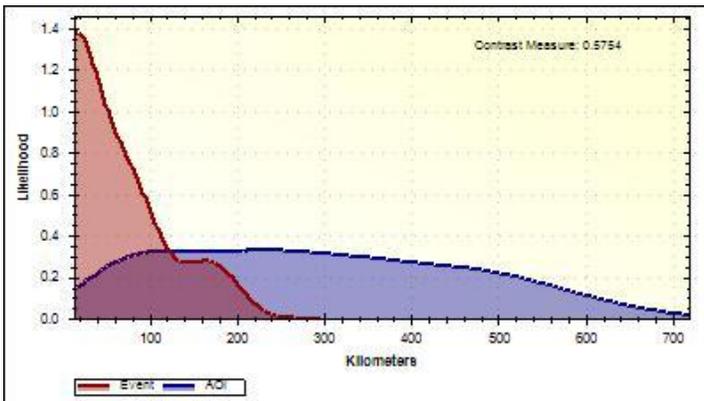


Fig. [45] GSPC NND POI Police Station

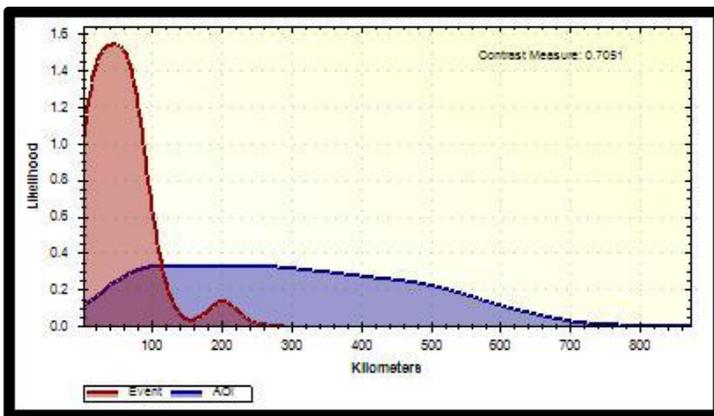


Fig. [46] AQIM NND POI Police Station

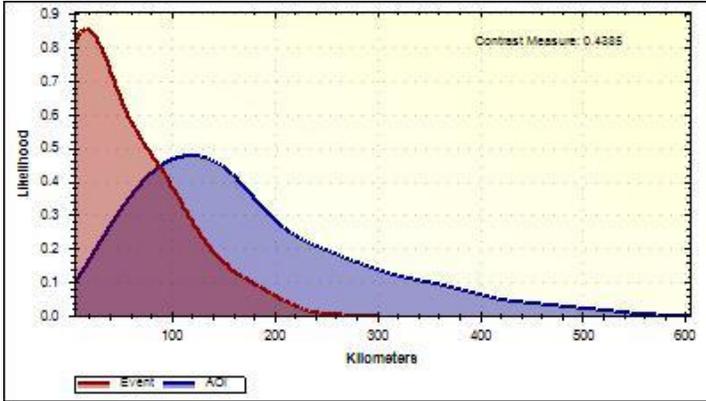


Fig. [47] GSPC NND POI School

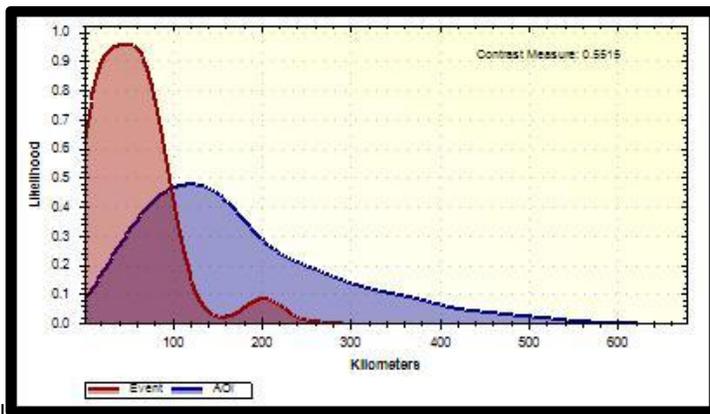


Fig. [48] AQIM NND POI School

SocioCultural Attributes: Education and Illiteracy

Education Factors included National Indices of Primary, Secondary and Superior Education, as well as Indices of No Education, and Illiteracy rates by *wilaya*. Factor Metrics and PDF Curves of Education data revealed similar relationships for AQIM and GSPC Events. High rates of primary, secondary and superior school education, relative to the national average, were all attractors for Event emergence while low illiteracy rates were also attractors. The data suggests that both AQIM and GSPC attacks emerge where the population is educated and literate and that wilayas with uneducated, illiterate populations are detractors for Event emergence. As the figures below show, Primary School Education, No Education, and Illiteracy were the most decisive factors for Event attraction [Figs. 49-59].

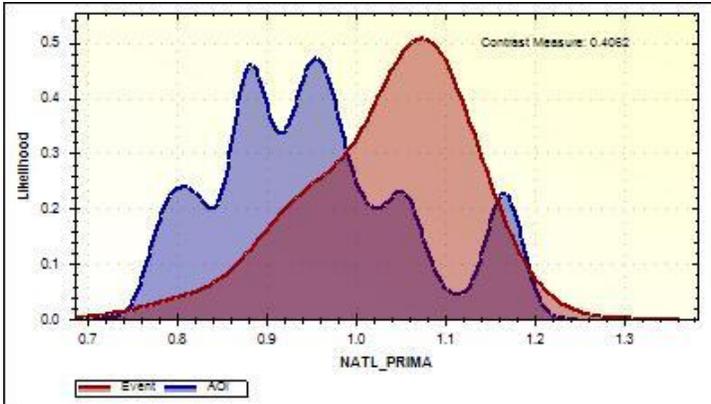


Fig. [49]GSPC NNV Index of Primary School Education

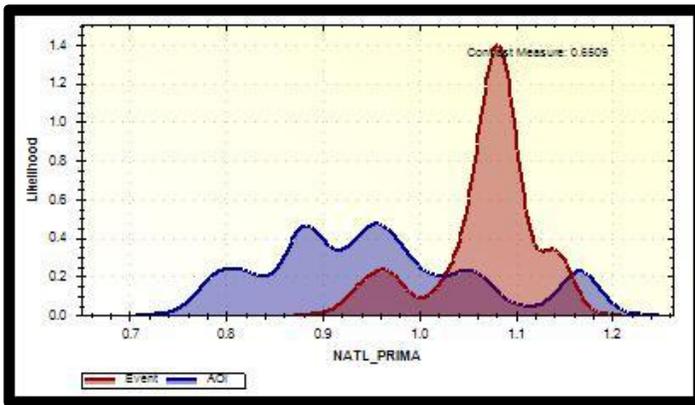


Fig. [50] AQIM NNV Index of Primary School Education

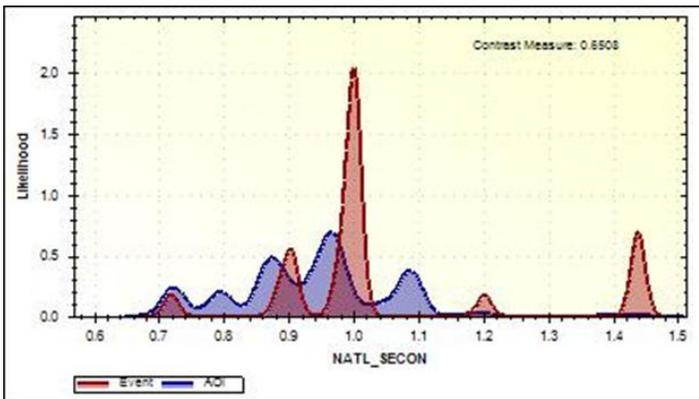


Fig. [52]GSPC NNV Index of Secondary Education

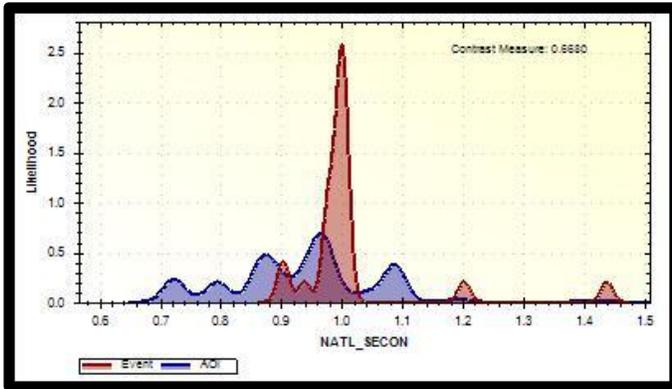


Fig. [53]AQIM NNV Index of Secondary Education

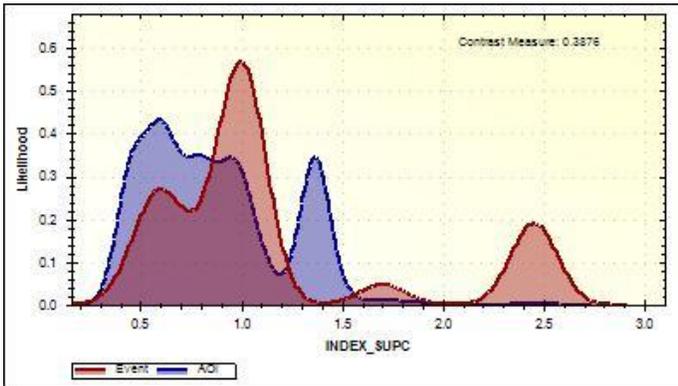


Fig. [54] GSPC NNV Index of Superior Education

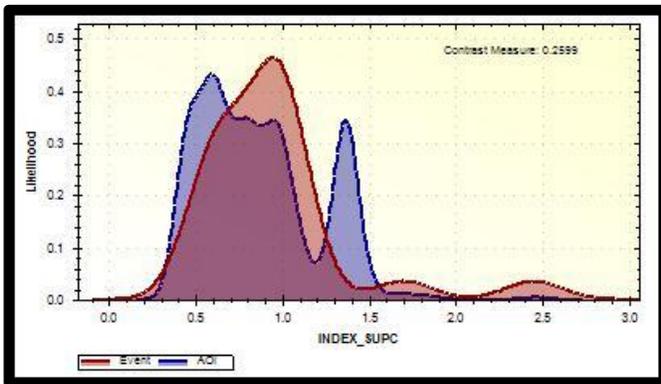


Fig. [55] AQIM NNV Index of Superior Education

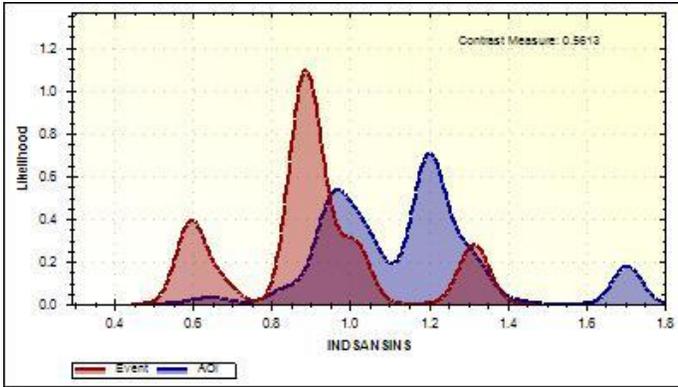


Fig. [56]GSPC NNV Index of Uneducated

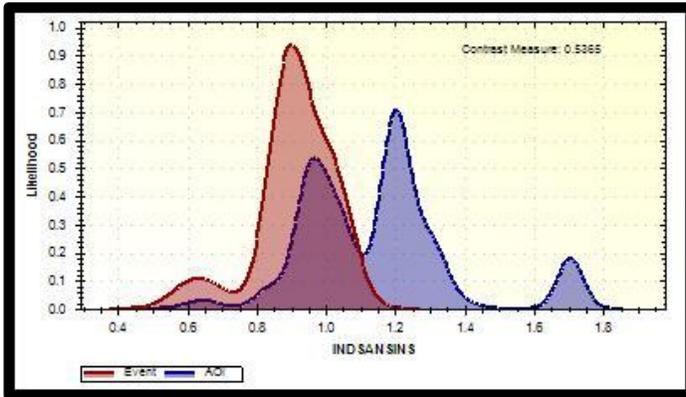


Fig. [57]AQIM NNV Index of Uneducated

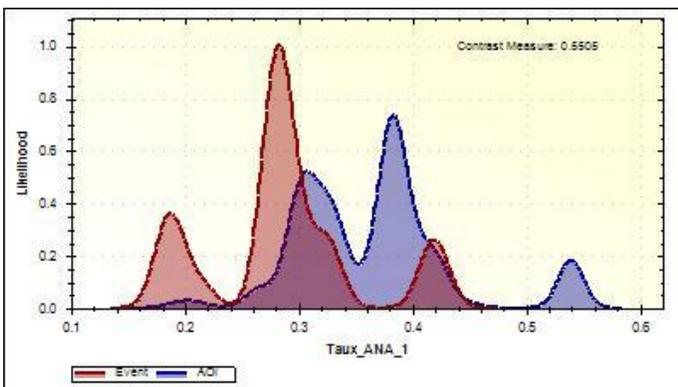


Fig. [58] GSPC NNV Illiteracy Rate

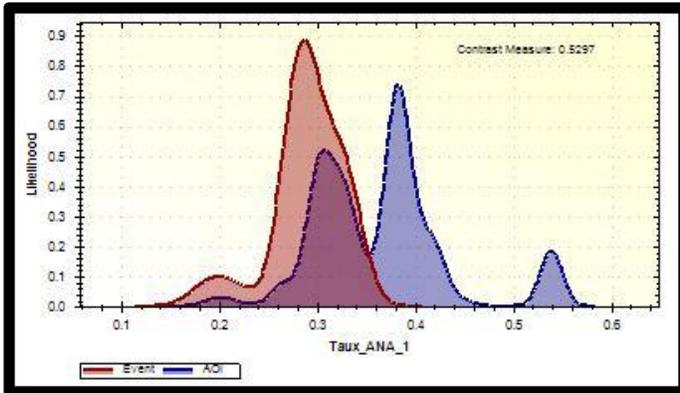


Fig. [59] AQIM NNV Illiteracy Rate

Demographics: Gender, Marital Status, Population

The final set of demographic attributes investigated included gender, marital status, and population density and growths. Factors evaluated included Indices of Masculinity (Male to Female Ratios), as well as Marriage, Divorce, and Single Indices by *wilaya*, where the Average National Index equals =1. For Population, both growth and density were considered. Exemplary Factors Metrics that describe the following statements about Factor/Event relationships are presented in Figures 60 through 71. Again, Factor Metrics between GSPC and AQIM Events are nearly identical for the Demographic Factors under investigation. A few nuances will be mentioned. For Masculinity Index, the Likelihood peak for the GSPC hovers at 1 (the National Index), while AQIM expresses a more clear peak just over the national average. This indicates that AQIM events are likely to emerge where the Masculinity Index is larger than the National Average. Both the GSPC and AQIM showed higher Event Emergence at a Single incidence greater than the national average, a lower marriage index than the national average, and a much lower divorce index than the national average. In short, populations with a larger male index and with low marriage and divorce rates and a high index of unmarried individuals will be likely places for terrorist incidents to emerge. Finally, in terms of population, lower percentages of population growth and higher population densities are attractors for both GSPC and AQIM Events.

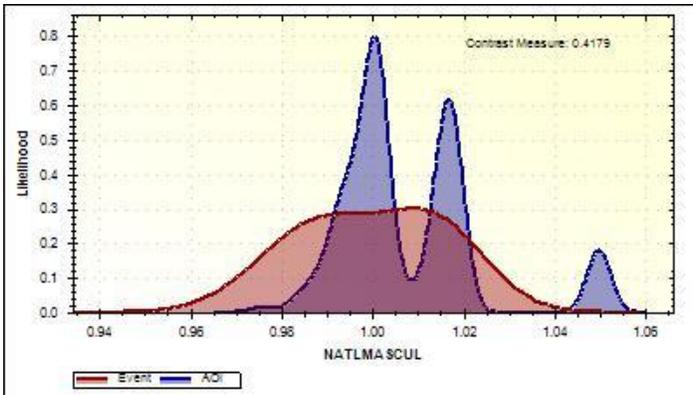


Fig. [60] GSPC NNV Masculinity Index

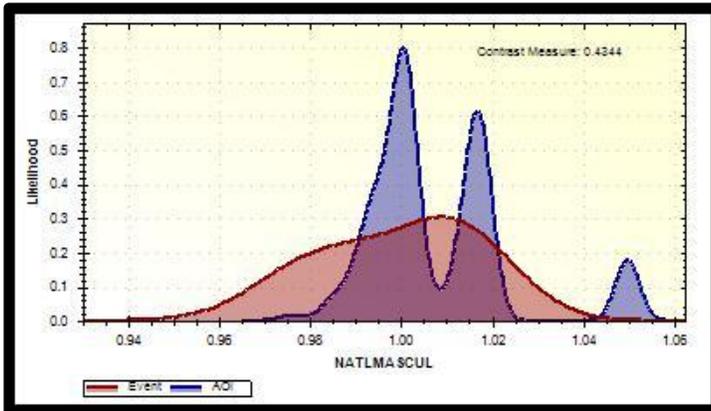


Fig. [61] AQIM NNV Masculinity Index

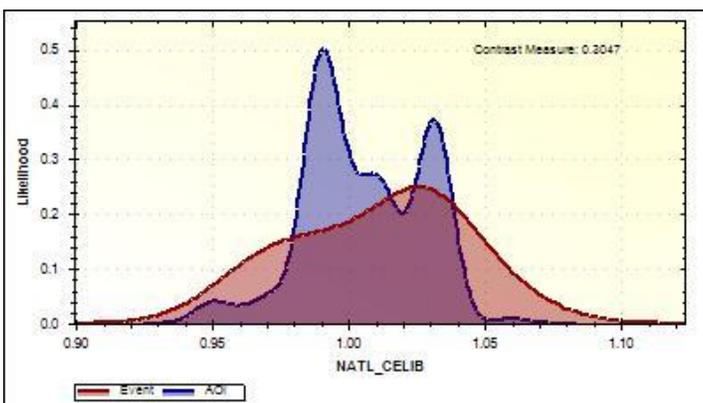


Fig. [62] GSPC NNV Single Index

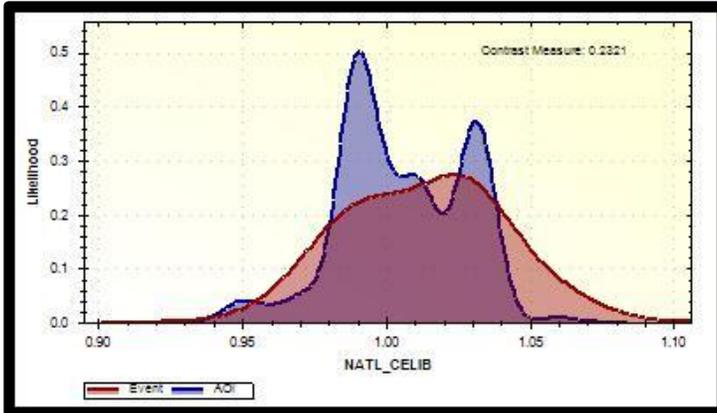


Fig. [63] AQIM NNV Single Index

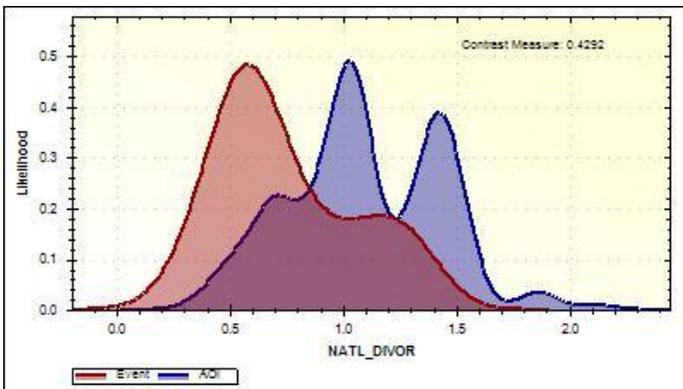


Fig. [64] GSPC NNV Divorce Index

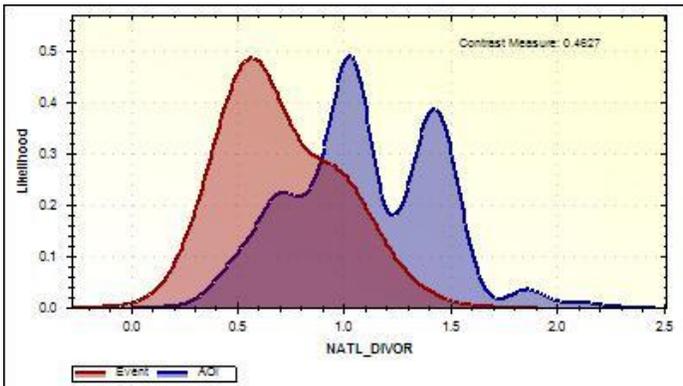


Fig. [65] AQIM NNV Divorce Index

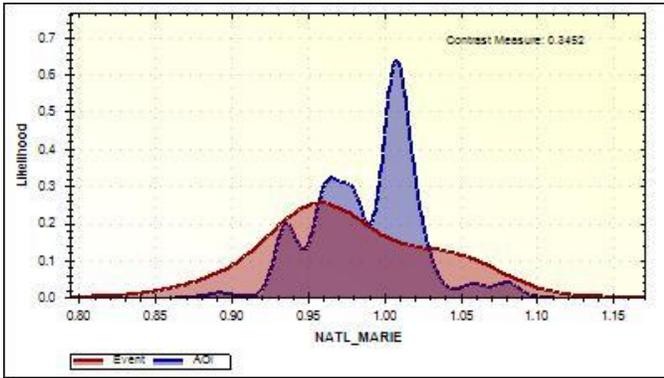


Fig. [66] GSPC NNV Marital Index

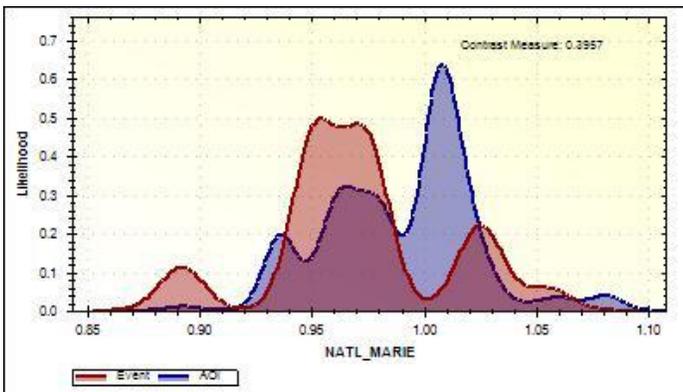


Fig. [67] AQIM NNV Marital Index

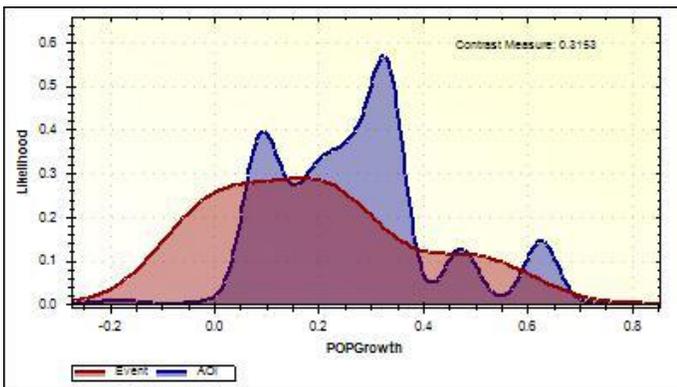


Fig. [68] GSPC NNV POP Growth

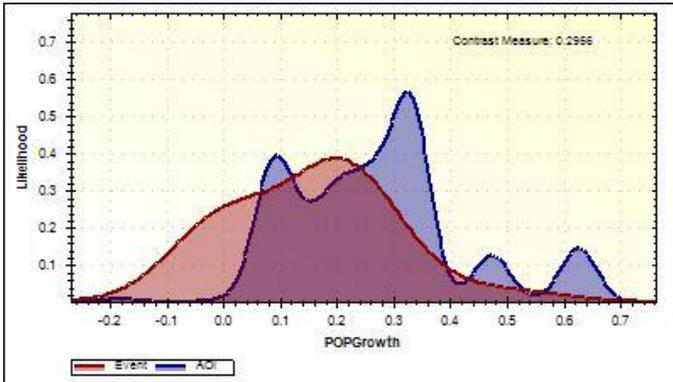


Fig. [69] AQIM NNV POP Growth

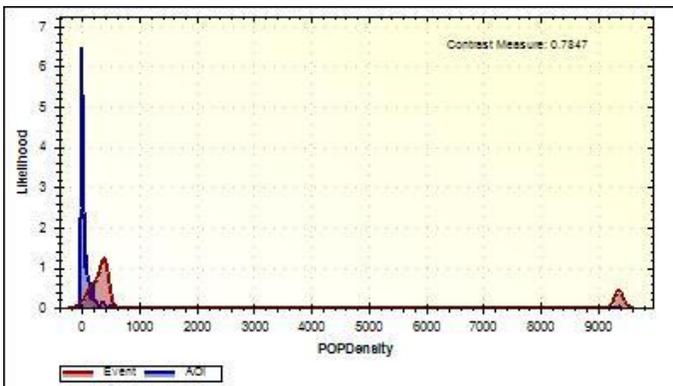


Fig. [70] GSPC NNV POP Density (persons/sq. km)

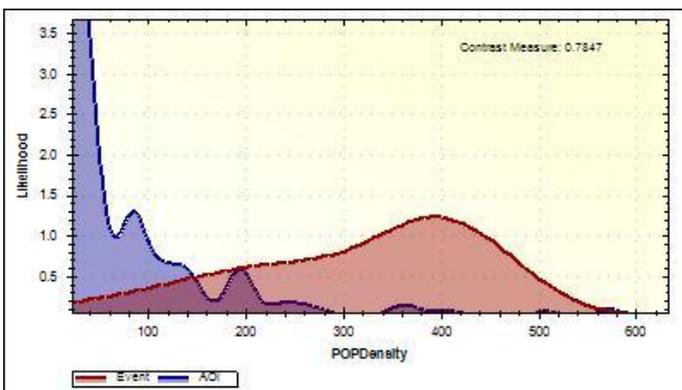


Fig. [71] GSPC NNV POP Density (persons/sq. km) Detail.

Commercial Factors

In the absence of data regarding international investment or business, commerce data provided by Algerian Office of Statistics was used as a proxy to evaluate whether import/export and industrial commerce (often likely to be sources of international involvement or business entities) bore any relationship to Event emergence. Commerce data for each *wilaya*, as divided by commercial sector (retail, wholesale, service, import/export/, industrial, artesanal) and evaluated in terms of a National Index (where 1= the National Index anything >1 is greater than the National Index, etc) and were run as separate Factors. The Metrics for each are detailed in the Figures below. Overall, GSPC and AQIM Events displayed similar relationships to the Factors. Low Indices of Artesanal Commerce and high indices of Industrial Commerce were also attractors. Although the Likelihood Value of Event Emergence peaked lower than the National Index for Import/Export, it was nonetheless higher than for the AOI of the northern *wilaya* (it should be noted that much of the Import/Export Commerce emerges from the gas and oil industries in the Southern Platform and it was therefore not surprising that emergence of Events in the northern *wilaya* AOI did not have a better Likelihood at a higher Import/Export Index. It is noteworthy that AQIM Events did express a higher Likelihood Value for a higher Import/Export Index than GSPC Events. AQIM Events also exhibited a higher Likelihood Value at a higher Index of Industrial Commerce.

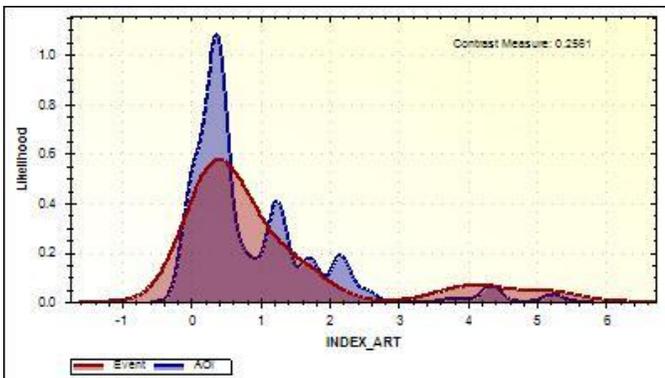


Fig. [72] GSPC NNV Artesanal Commerce Index

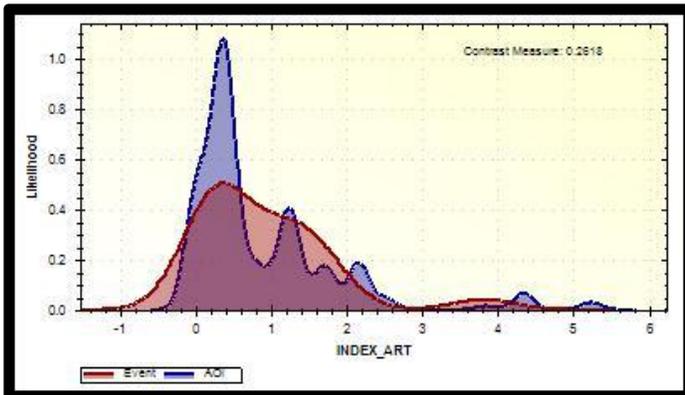


Fig. [73] AQIM NNV Artisanal Commerce Index

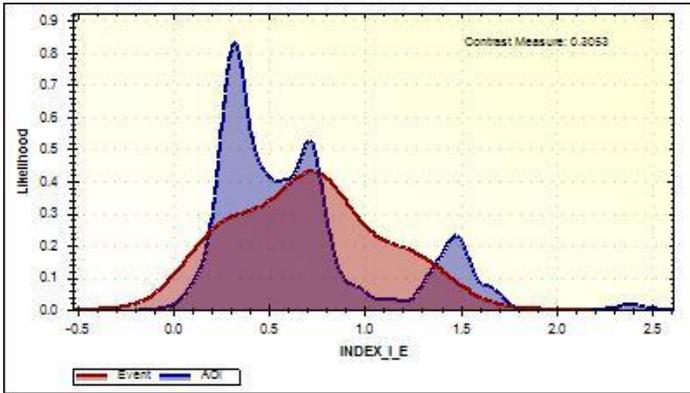


Fig. [71] GSPC NNV Import/Export Commerce Index

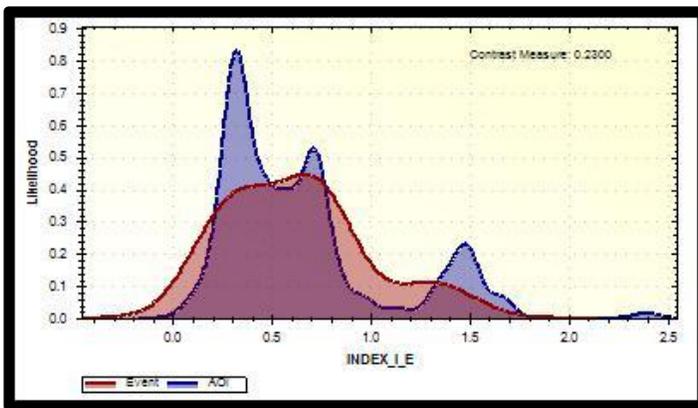


Fig. [71] AQIM NNV Import/Export Commerce Index

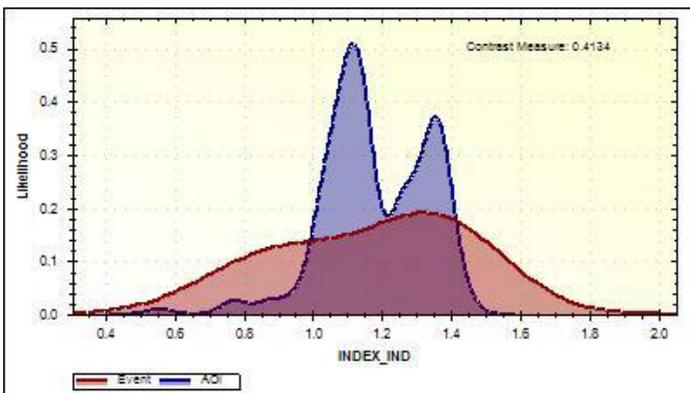


Fig. [71] GSPC NNV Industrial Commerce Index

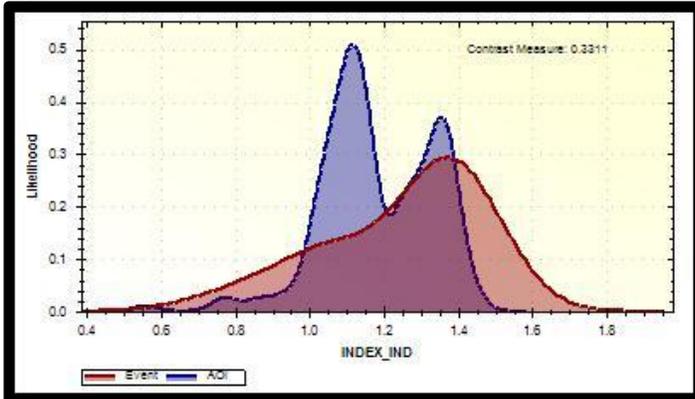


Fig. [71] AQIM NNV Industrial Commerce Index

FINAL ASSESSMENT & SUMMARY

The above interpretation of Factor Metrics validates certain geospatial similarities between GSPC and AQIM Activity across life, intellectual, and physical spaces. Apart from expected Event attraction to police stations, infrastructure, lodging, utility and pipelines, and the mountainous ethnic region of Kabylie, specific links to Kabylie, Education, Marital Status, Population Density, Military Airports, Railways, and Mining Sites for Nonmetals were found. Numerous key differences, or at least nuances, for likelihood of GSPC versus AQIM Event emergence were also exposed. Land cover, commerce, and transport hierarchies presented distinguishing factors between the groups. It is certainly possible that a selection of different Validation Points (Events) for the GSPC and AQIM might reveal further distinguishing signatures between the terrorist organizations likely emergent activity. While further Subject Matter Expertise is required to determine whether or not the observed Event/Factor relationships are directly linked to changes in ideology and tactics as the GSPC absorbed Al-Qaeda ideology and was subsequently absorbed by Al-Qaeda as the new entity AQIM, the above empirical research certainly gives analysts an objective framework from which to consider the signature tactics of local terrorist organizations as they give allegiance to Al-Qaeda. For example, Black's theory (2008) about AQIM and GSPC ideological reliance on and exhortations to Berber Kabylie, as an exemplar of the successful Pan-Islamic struggle, is here empirically proven to be a constituent part of both GSPC and now AQIM tactic. Black notes the following AQIM invocation of eighth century Umayyad military leader and ethnic Berber from Algeria who led Muslim forces into al-Andalus in his observation that AQIM and the GSPC have used Kabylie's terrain as an operational base: "the opportunity to call on our brothers, the free Kabylies, descendants of Tariq bin Ziyad, to stand in the ranks of our brothers, the mujahideen, against these traitorous rulers. We remind you that our jihad is in defense of the religion of the umma [Muslim nation] and its sanctities, and is [meant] to do away with the oppression that rules high-handedly over all the Muslims—including our brothers the Kabyles, who have suffered woes at the hands of an apostate gang that represses every free voice that opposes the oppression, the corruption, and the tyranny" (ekhlass.info, February 17). At the same time, Black questions whether Berber and AQIM divergent agendas will lead to cooperation. While the SA data shown here cannot evaluate the extent or motives of cooperation, the fact that Event Emergence in Kabylie is more closely tied to the contemporary, political geography of Kabylie (as defined by the MAK) rather than the historic, linguistic and cultural region of Kabylie empirically proves crossover of landscapes between the two political/ideological movements (AQIM and the Autonomous Berber movement) and further

investigation is warranted. The Factor Metric comparison between the GSPC and AQIM presented herein this produce new lines of inquiry, and offer the opportunity to validate hypotheses about the nature of the organizations' tactics, ideology, operational base, and how these characteristics changed from the GSPC's first flirtations with Al-Qaeda to its official rebirth as AQIM.

In addition to qualitative and quantitative comparisons of the GSPC and AQIM, the Factor Metric Assessment of this study can be used for spatial predictive modeling of emergent AQIM activity. After the above analysis was performed and all Factors were carefully examined as attractors or repellers for AQIM activity, disinformative Factors were eliminated and the predictive model for Event emergence was rerun to eliminate 'noise.' The following map [Fig. 72] details AQIM likelihood at a 10% threshold of hot spots within the AOI of the Northern *wilayat*, as based on the Events listed in Figure 4, and from the most influential Factors assessed and described in this study. Areas marked in red are those most likely for emergence of AQIM terrorist incidents.

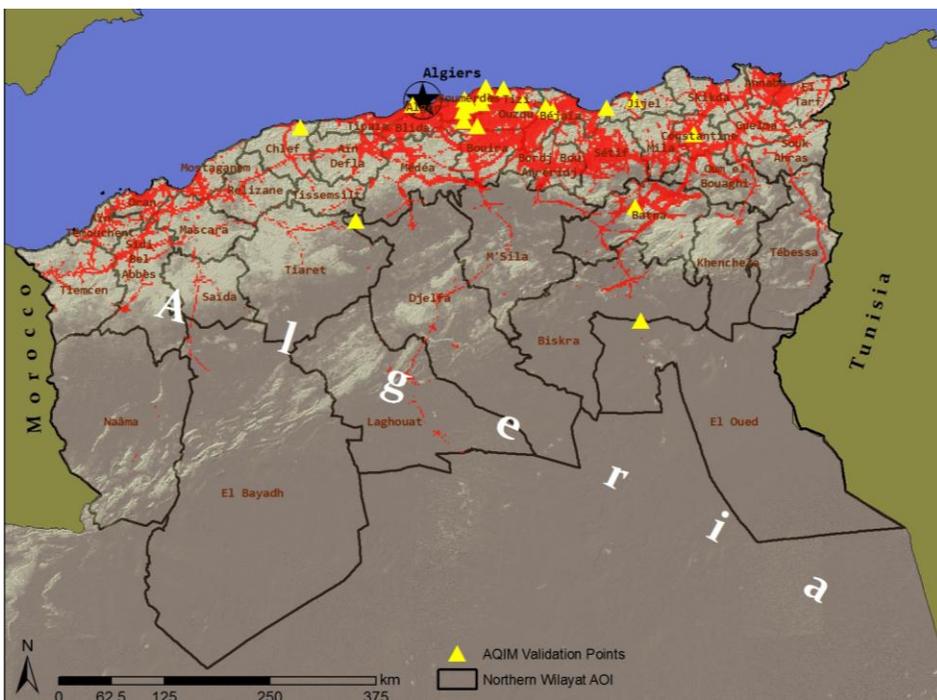


Fig. [72] Top AQIM Incident hot spots, based on selected Events and Factors presented in this study.

CAVEATS

A number of caveats in the quality and availability of Open Source data reduce the accuracy and hinder the opportunity to produce more meaningful results. First, the nonexistence of GSPC Events in the Worldwide Terrorist Incident System prior to the GSPC's allegiance to Al-Qaeda (September 2003) means that we can *only* compare geospatial signatures of the GSPC as it was an informal Al-Qaeda ally and as it was subsequently merged into AQIM. However, a thorough understanding of the ideological

and tactical transformation of a local terrorist organization, like the GSPC, as it is absorbed into Al Qaeda, would demand a 'control' assessment of the organization, pre Al-Qaeda. Unfortunately such data does not exist in the WITS system to perform a control test of the GSPC. The analysis presented here therefore can only consider comparisons and differences between the GSPC, as a loose affiliate of Al-Qaeda, and as an official branch of Al-Qaeda (AQIM). These two unique phases in the GSPC's trajectory of maturation from a regionally motivated terrorist group to an internationally driven organization could unfortunately not be pitted against its earlier years, when the tactics and ideology were exclusive to nationalist issues in Algeria.

Coarseness of the event data was also a primary concern. Namely, documentation by WITS—which only lists the city and often, only the district, of the terrorist incident, lacks precision, is ambiguous in many cases and partial information about the incidents. Access to specific coordinates of incidents rather than attributing them to general coordinates of a city or village, as WITS did, would improve quality, completeness, and precision of the results. For example, attacks occurring at a distance from a town or village may only be identified in WITS as occurring in a certain district of a province. Without further clarification as to the zone of the province in which the incident occurred, these incidents had to be completely removed from the trial set of Validation Points.

Finally, owing to the purely Open Source origins of this research, the data (including both Events and Factors) and therefore the analysis are necessarily incomplete. Many additional Factors would have tremendously supplemented the Assessment, for instance: point data for all international business and current infrastructure projects, improved data on location of police stations and police/security training centers, more accurate and complete data on hotels and lodging, or statistical data at the district or town/city level rather than *wilaya* level could have improved accuracy. Certainly, resources like the Business Bureau of Algeria could have been scoured, but such research is time-intensive. In many cases, Factor Metrics relied on incomplete rather than seamless information coverage (such as POIs provided by OpenStreetMap) and proxy information for Factors that could not be acquired (i.e. general commerce data that was available for each *wilaya* became a proxy for international business).

CONCLUDING REMARKS

This project has used Signature Analyst to glean actionable insight on the evolution of GSPC as it absorbed Al-Qaeda ideology and tactics and as it was ultimately absorbed by Al-Qaeda in the formation of a new entity, Al-Qaeda in the Islamic Maghrib. Additionally, the geospatial signature developed for AQIM, permits statements of likelihood for event occurrence or emergence and can allow for resource allocation to 'hot areas'. Most of all, this analysis has demonstrated the need to pair data and empirical analysis with knowledge: "Geospatial knowledge creation involves much more than automated data handling and is a complex cognitive process involving perception, learning, communication, association, and reasoning (Bacastow and Bellafiore 2008)." Even in the data foraging and evidence development process, multiple Factor sources were pitted against each other to see how and if "official" data (i.e. Digital Chart of the World) and Volunteered Geographic Information (i.e. OpenStreetMap) corroborated the same spatial relationships between Factors/Events or to uncover additional nuances. In order to arrive at meaningful and accurate empirically derived outputs, SA demands complex human processes of knowledge and intuition to create the initial model inputs and especially as the analyst interprets Factor Metrics and returns to the data foraging process and modification of inputs as unknown geospatial relationships are discovered. Ultimately, Signature Analyst proved to be a superb testing ground for the application of Structured Geospatial Analytic Methods and SGAM proved indispensable to SA.

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Many thanks to software developers and geospatial scientists at SPADAC for their expert advice on the use of Signature Analysis and interpretation of SA outputs.

DATA SOURCES (all files were projected to WGS 84 UTM zone 31N)

GIS Data Depot

<http://data.geocomm.com/>

Country Boundary Files, Wilayat Boundary Files

Utility Line

Transportation (Rail, Roads, Aeronautical)

World Place Name Gazetteer for Algeria

DIVA-GIS

<http://www.diva-gis.org/datadown>
Country Boundary Files

WITS

<https://wits.nctc.gov/>
Algeria Terrorist Incidents

CGIAR

<http://srtm.csi.cgiar.org/>
90m SRTM

OpenStreetMap data acquired by CloudMade

http://downloads.cloudmade.com/africa/algeria#downloads_breadcrumbs
Points of Interest
Highways

Office National des Statistiques, Algérie (ONS)

<http://www.ons.dz>
Commerce data
Education data
Demographics data

Africa Land Cover-Global Land Cover Characterization

edc2.usgs.gov/glcc/af_int.php

USGS World Petroleum Assessment

<http://energy.cr.usgs.gov/WEcont/wepubfinal/dwncov.htm>
Oil and Gas Pipelines

Mouvement pour l'Autonomie de la Kabylie

<http://mak.makabylie.info/>
Kabylie Political boundaries

International Mother Language Day

<http://imld.i-iter.org/en/content/kabyle-language-map>
Kabylie Linguistic boundaries