20 April 2009

Open Source Center   *Analysis*

Afghanistan **-- Geospatial Analysis Reveals Patterns in Terrorist Incidents 2004-2008**

OSC's geospatial analysis of incidents within the National Counterterrorism Center (NCTC) Worldwide Incidents Tracking System (WITS) database provides insight into terrorist incidents in Afghanistan reported in open sources from 2004 through the end of 2008 and compares them against an OSC-developed predictive model. Various types of analysis of the WITS data revealed spatial patterns and a distribution of incidents that would be valuable to those interested in the dynamics of Afghanistan's security. Analyses included in this study are as follows: mapping incident density, identifying the dominant ethnic group where incidents occurred, mapping incidents by district, mapping incidents by province, identifying the mean center of incidents over time, calculating the standard deviation (spatial pattern/trend) of overall incidents, mapping total incidents by month, and computing the mean center of incidents by month.

Incident analysis is based on data from NCTC's WITS database at: http://wits.nctc.gov/.

Key Applications

The table below outlines some of the most important applications for this analysis and provides links to the maps best suited for viewing the associated applications. Double-click the icons beneath each map to open them to full size.

Note: The Geostatistical and Temporal Analysis maps are interactive GeoPDFs. Use the "layers" option in Adobe Reader to turn layers off and on.

**Geostatistical Analysis of Incident Data**

- Identify hotspots for terrorist incidents

- Identify geographic distribution of incidents and their mean center

- View distributions of deaths and kidnappings

- Analyze incidents by ethnic group and population

- Analyze incidents by district/province
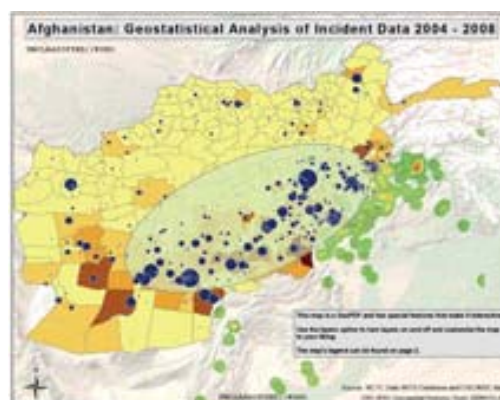
Geostatistical Analysis.pdf: 📎


Temporal Analysis of Incident Data

- View terrorist incidents by year

- View mean location of incidents by year

- Analyze changes in incidents by month

- Compare with suicide attacks in Pakistan

- Compare incident locations with a geospatial predictive model
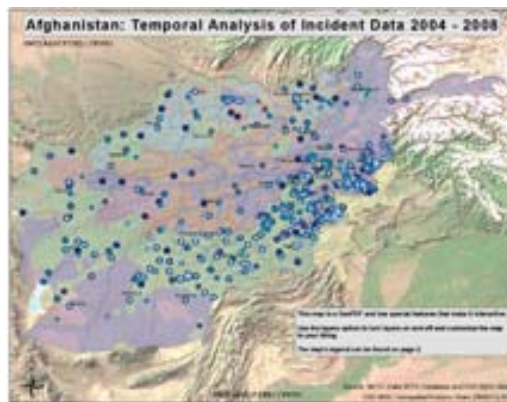
Temporal Analysis.pdf:
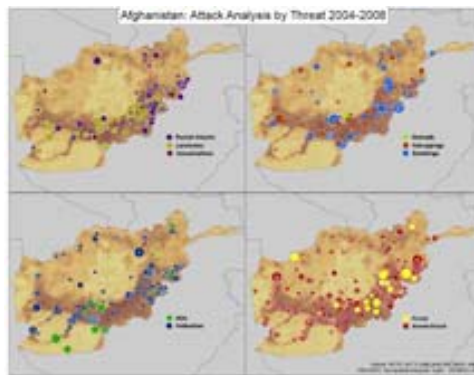
3-Dimensional View of Attack Density

- View distribution of the incidents in three dimensions
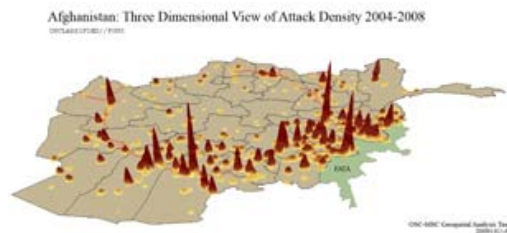
3D View.pdf:

Attack Analysis by Threat

- View incident analysis organized by threat type

- Compare rocket attacks, land Mines, assassinations, grenade attacks, Kidnappings, bombings, IEDs, ambushes, arson, and armed attacks
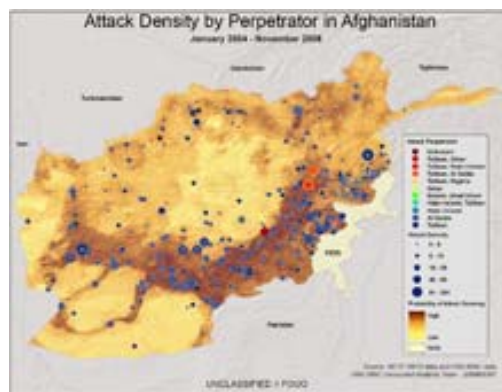
Incident Density Threat Type.pdf:

Attack Density by Perpetrator

- View incidents organized by perpetrator

- Compare incidents with OSC predictive model

Incident Density Perpetrator.pdf:

3-Dimensional View of Incidents

- Analyze incidents in a three-dimensional environment

Google Earth KMZ document:

Note: Source data in ArcGIS-compatible formats are available upon request.

Geospatial Analysis Project Data

In its native format, the WITS data, obtained from wits.nctc.gov, is not suitable for geospatial analysis; for example, the database includes a "subject" field which contains both the event location and its description. Location coordinates are not provided. A member of the PSCB, Taliban Special Issue Branch, provided OSC with a spreadsheet containing the named location, usually a city or village, in a unique field. OSC identified latitude and longitude for incident locations using several place-name identification tools. Of the 4,129 incidents included in the database, 80% were located at the city or village level. Only 16% were located at the provincial level, and 4% were located at the district level.

WITS data include fields identifying the incident perpetrator, country, subject (description), number dead, number wounded, number of hostages, and total victims. Additional fields could be extracted from the description field, including location, month, and year. In Afghanistan, incident perpetrators include Al-Qa'ida, Taliban, Hizb-i-Islami, and others. Threat types were reported as ambush, armed attack, arson, assassination, bombing, grenade, IED, kidnapping, land mine, or rocket attack.

OSC used ESRI data to provide base data for the map and Landscan 2007 data, produced by Oakridge National Laboratories, for population estimates.

Analysis Techniques, Observations

The following sections provide brief descriptions of the analysis techniques used in this study and note some analytic observations, but the data can be viewed best in the KMZ or GeoPDF formats.

*Adding Contextual Information From Suicide Attacks in Pakistan*

Since datasets are often limited to a specific region, it is difficult to perform geographic studies on cross-border issues, such as this one. To provide further context to the Afghanistan incident study, a layer containing the density of open source-derived suicide attacks in Pakistan was included as well. The map below shows the density of terrorist attacks in Afghanistan from 2004-2008 in conjunction with the density of suicide attacks in Pakistan for 2008. Together, the datasets reflect the nature of the cross-border conflict in the FATA region. Mapping the incidents makes hotspot analysis possible and provides valuable information to those responsible for operations in the region.
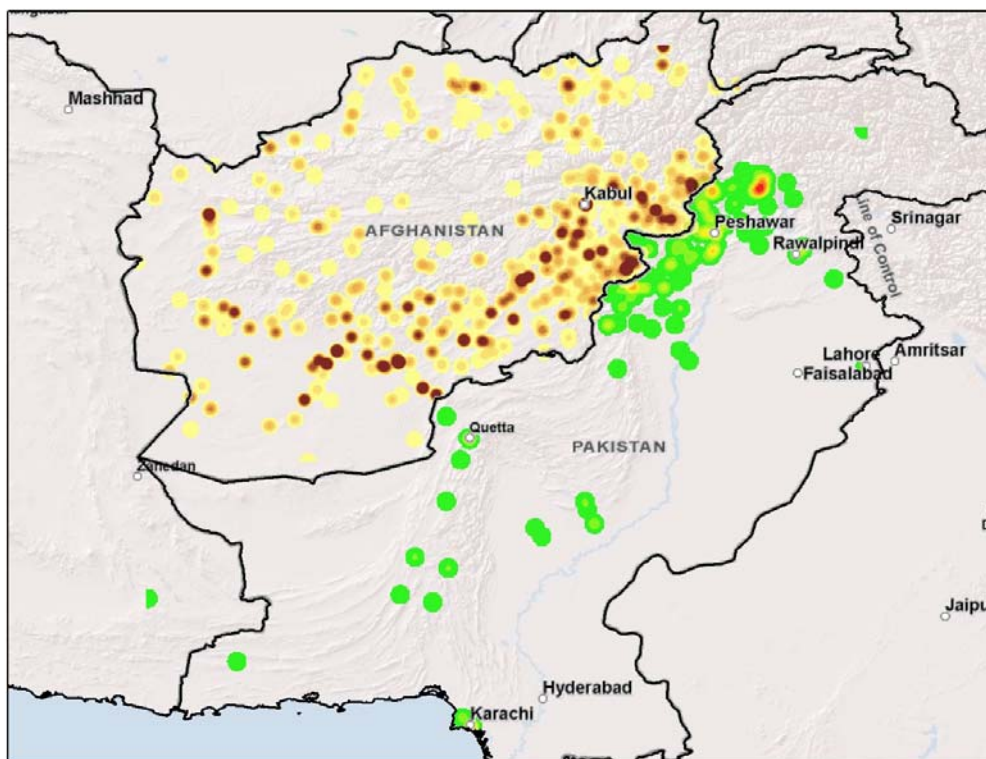
Benefits of 3-Dimensional View of Incidents

The graphic below depicts the intensity of terrorist incidents in Afghanistan from a three-dimensional perspective. This view makes it easier to compare the actual quantity of attacks compared with other places.
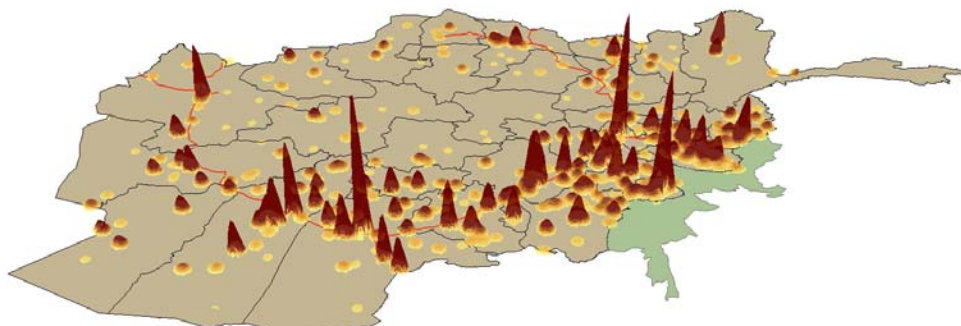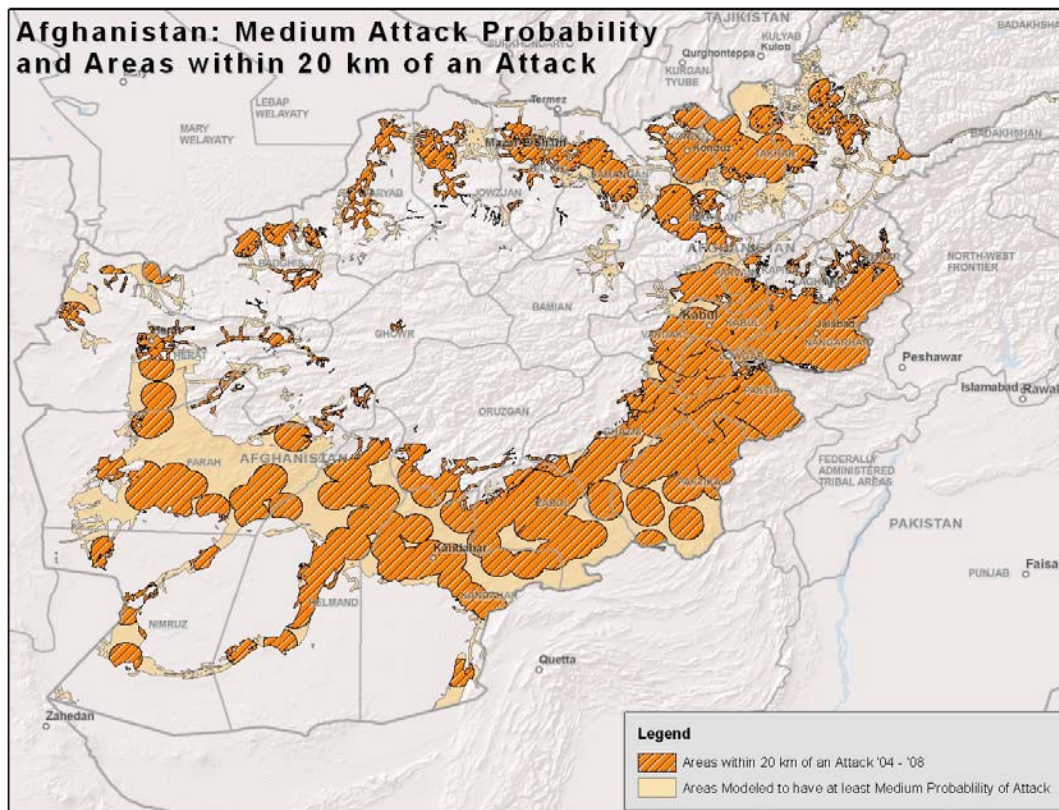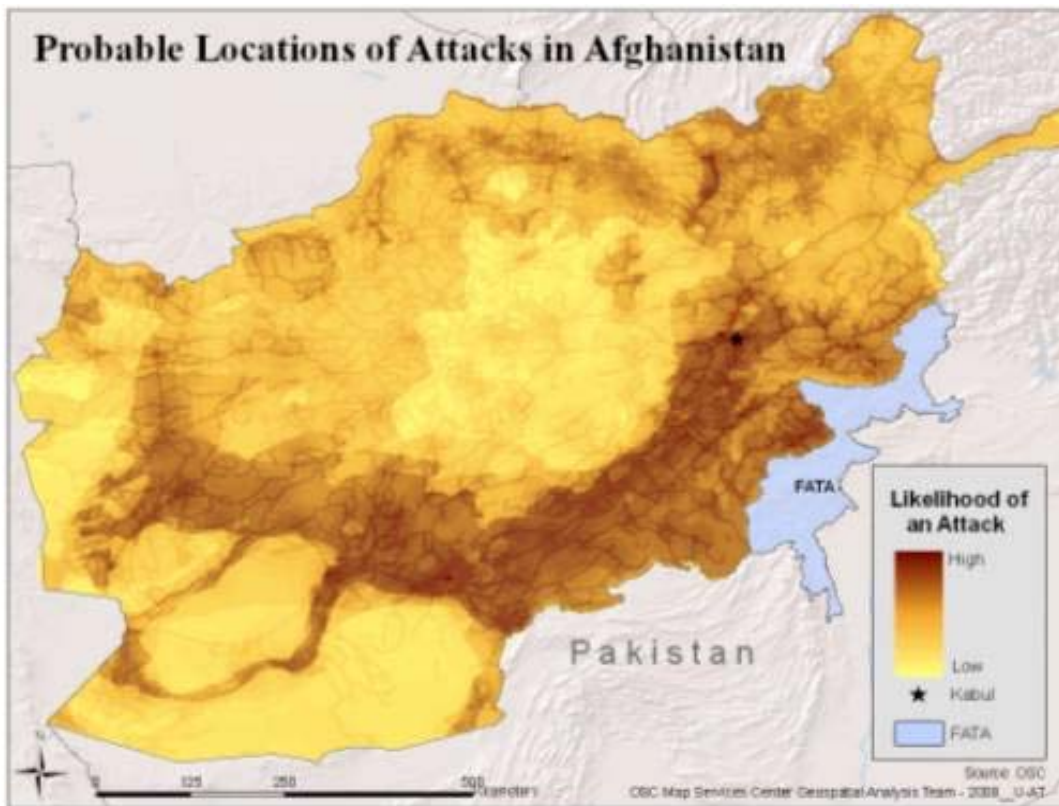

Comparison of WITS Spatial Trends to OSC's Predictive Model

OSC's predictive model,[a] developed in October 2008, uses three months of incident data from open sources to predict where future Afghan attacks would occur (see map below). The model was based on common geographic features that tended to coincide with terrorist incidents. Because the WITS database contains five years of incident data -- compared to the predictive model which utilized three months of incident data -- the additional information provides an opportunity to evaluate the validity of the predictive model.

Some 92% of incidents reported in NCTC's WITS database occurred in locations that were predicted to have at least a medium probability for terrorist incidents. About 69% of the incidents occurred at locations with a high probability for an attack. When a 20 kilometer buffer was created around each incident location, 68% of areas deemed to be of at least medium likelihood were covered by the 20 kilometer terrorist incident buffer (see map).

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[a] For more information on OSC's predictive model, see the 15 October 2008 OSC Analysis, **Geostatistical Methods To Predict Afghanistan Attack Locations** (IAF20081015573001).

Probable Locations of Attacks in Afghanistan

Afghanistan: Medium Attack Probability and Areas within 20 km of an Attack

This information provides further evidence that, based on current incident patterns, the raster model's ability to predict areas sensitive/vulnerable to attack is noteworthy. Areas of higher population have, not surprisingly, experienced the highest number of incidents. Therefore, OSC sought to identify where the most incidents occurred, compared to the estimated number of inhabitants for each district.

Incidents Compared With Population

The following graphic shows the number of incidents per district, normalized by the estimated population within each district. It shows where violence is especially high in consideration of the population size of that district. This graphic can potentially indicate less populated regions that may be of strategic importance to Taliban and NATO interests.
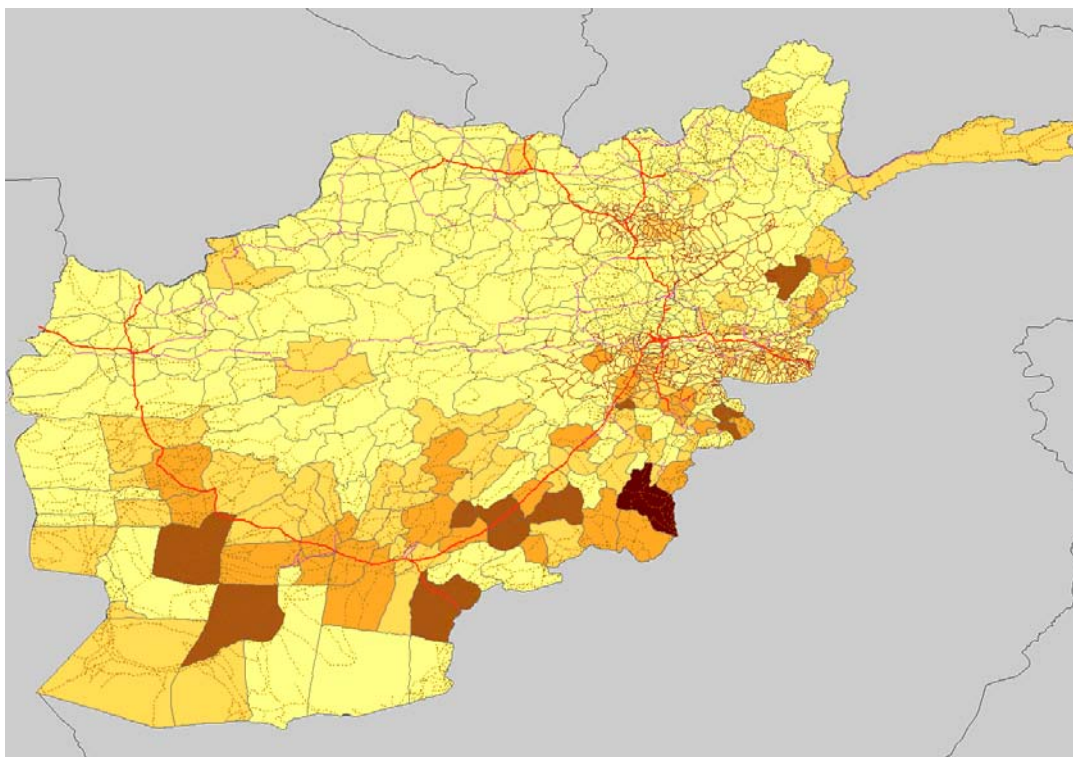
Analysis of Perpetrator Data

The WITS data contained a field identifying the perpetrator of each incident. Not surprisingly, the vast majority of incidents were instigated by Taliban and other Taliban-related entities. The data indicate that 64% of the incidents were carried out solely by the Taliban, and 33% of the incidents had unknown perpetrators. Because many incident reports omitted information on the perpetrator, it is likely that many of the perpetrators classified as "unknown" are likely to be Taliban. The following table outlines the percentage of incidents performed by various terrorist groups:

Perpetrator	% of Incidents
Taliban	64%
Unknown	33%
Taliban, Al-Qa'ida	2%
Al-Qa'ida	1%
Taliban, Other	0.3%
Hizb-i-Islami	0.21%
Islamic Jihad Union	0.17%
Taliban, Hizb-i-Islami	0.09%
Hizb-i-Islami, Taliban	0.03%
Other	0.02%
Taliban, Nigeria	0.02%

A simple analysis reveals the change over time by perpetrator. The data show that the Taliban and unknown perpetrators remained the two highest contributors to incidents for each year of the study, 2004-2008.

Analysis of Threat (Incident) Types

The WITS data contained a field identifying the type of threat. The majority of attacks came in the form of IEDs and armed attacks at 42% and 36% respectively. Refer to the Threat Analysis PDF or .KMZ file to see a map of the incidents symbolized by the different threat types. The following table outlines the percentage of incidents by threat type.

Threat Type	% of Incidents
IED	42%
Armed Attack	36%
Kidnapping	7%
Bombing	6%
Land Mine	6%
Rocket Attack	3%
Ambush	0.46%
Arson	0.32%
Grenade	0.07%
Assassination	0%

Geographic Mean Center of Incidents

See the Geostatistical Analysis GeoPDF or .KMZ file to view this data layer.

OSC located the average geographic center of the incident data for each year to track the general changes of incident distribution. Overall, there appears to be a general shift in incident distribution from east to west over time. Incidents in 2005 appear to shift to the south, and incidents in 2006-2007 shift back to the north from 2006-2007. Changes overall appear to be subtle and do not indicate dramatic change of the mean center location over time. Among other possibilities, this could indicate that the Taliban's targets for violent attacks have changed little over time.

Standard Deviation

See the Geostatistical Analysis GeoPDF or .KMZ file to view this data layer.

This statistic, represented by an ellipse in the map, reflects direction and trend of the attacks in Afghanistan, indicating that most incidents are located in the western portion of the country, ranging from the southeast to the northwest. The ellipse covers one standard deviation worth of data, or about 68% of the incidents. The mean center, discussed in the previous section, is located near the center of the ellipse.
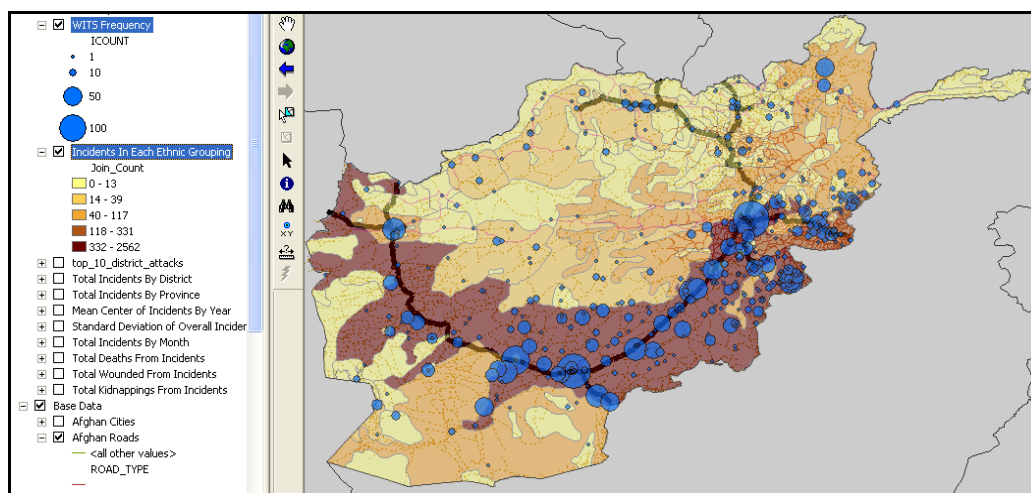
Analysis of Incidents by Month

See the Temporal Analysis GeoPDF or .KMZ file to view this data layer.

The mean center of incidents by month suggests interesting trends. For example, the mean center of incidents in the winter months moves south and to the west. Incidents recorded in the fall and summer months reflect a mean center further north and east. This change in location based on season is indicative of the rough terrain and climate that likely significantly affect the Taliban's abilities and strategy. Also of interest is how the quantity of incidents fluctuates on a seasonal basis.

Analysis of Incidents by Ethnic Groupings

Visualizing the amount of incidents located within a particular ethnic group (see map below) reveals interesting patterns. An overwhelming majority of incidents fall within the Pashtun ethnic group which dominates the area surrounding the main national highway of southern Afghanistan. The blue circles indicate incident hotspots, which follow the main national highway and predominately fall in the Pashtun ethnic areas. This information could provide important background for strategic planning.

It is important to consider that the ethnicity boundaries indicate the dominant ethnic group in that area. Not all persons in that region identify solely with that ethnic group.


*Analysis of Incidents by Province, District*

When mapping the number of incidents by district, a spatial pattern of incidents emerges (see map below). The majority of incidents occurred in three districts: Helmand, Kandahar, and Ghazni. Other violent districts tend to surround these provinces.

A clear picture emerges when the incident hotspots are overlaid on these provinces. The majority of incidents occurred in the Afghanistan-Pakistan border region. The amount of attacks near the border region suggests that many of the bordering provinces are most vulnerable to attacks. Other than being near the border with Pakistan, the three most violent provinces also contain some of the major cities of Afghanistan.
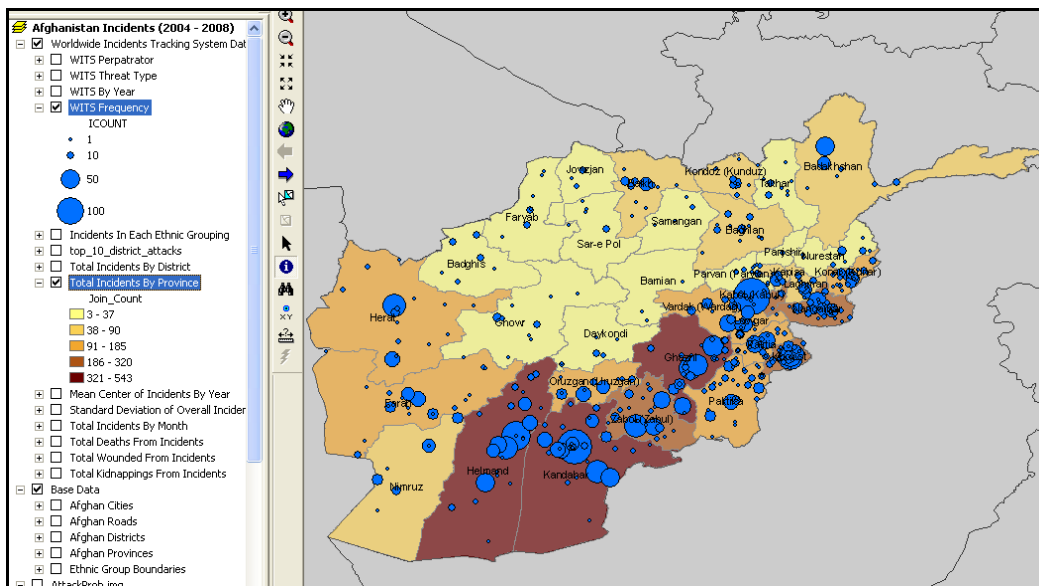
Mapping the incidents by district (see map below) makes it possible to examine problem areas in more detail. Most of the violent districts fall in the south and the eastern parts of the country. Again, proximity to the lawless border regions in Pakistan plays a significant role. Many of the districts that contain a higher number of incidents (darker colors) also contain population centers and have major road networks flowing through them. Some high incident districts also are seen in the west and north. These districts also contain major population centers. Higher concentrations of people and infrastructure will be more susceptible to incidents than smaller, less built-up areas of the country.
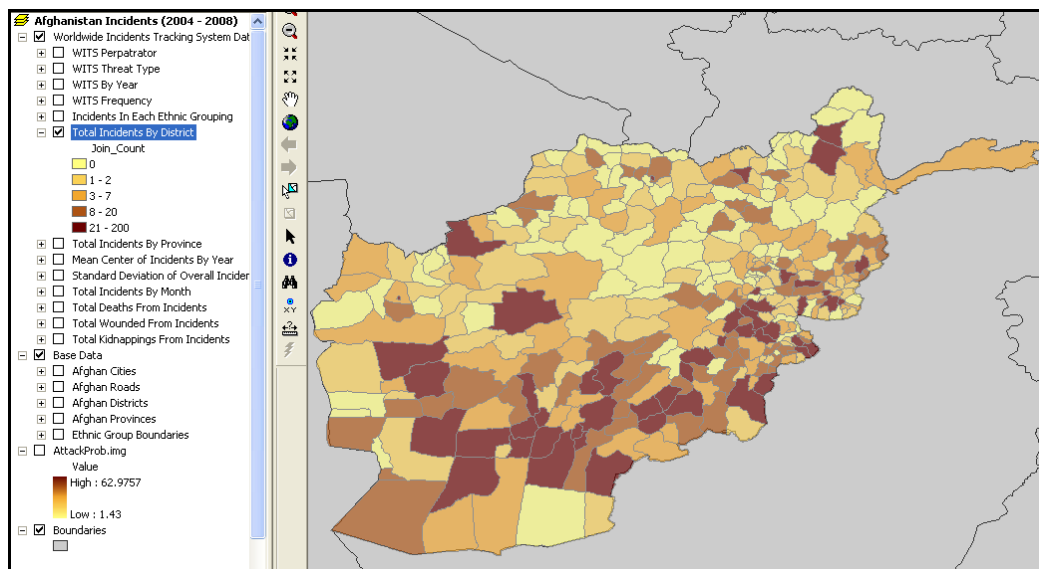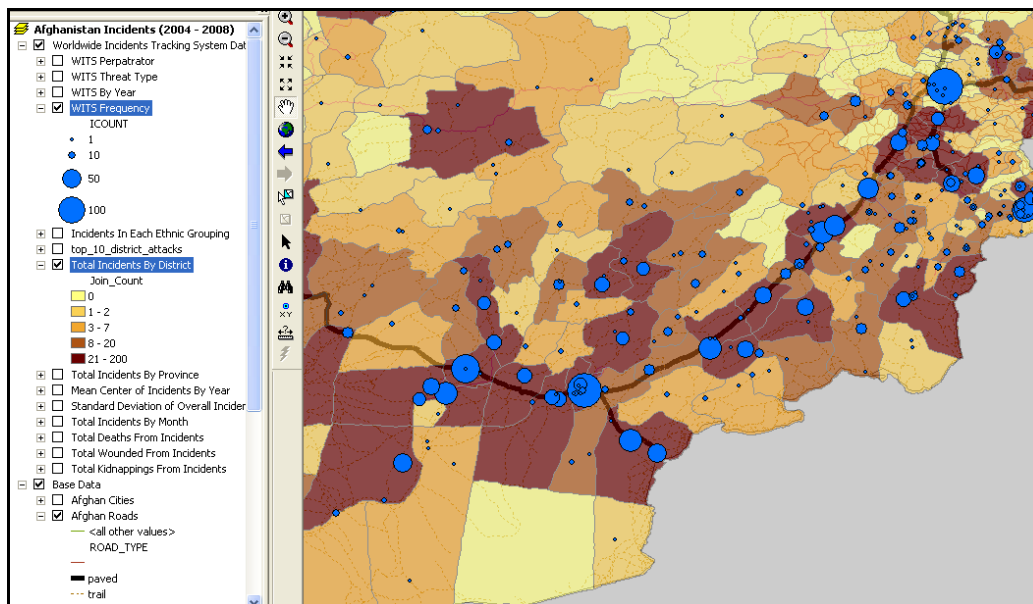

The bar chart below further illustrates this point. The two most violent districts were Kandahar and Kabul, each housing the two most populous cities of Kandahar and Kabul. They are also two of the most accessible cities in the country.

Districts With Most Incidents - Afghanistan (2004 - 2008)
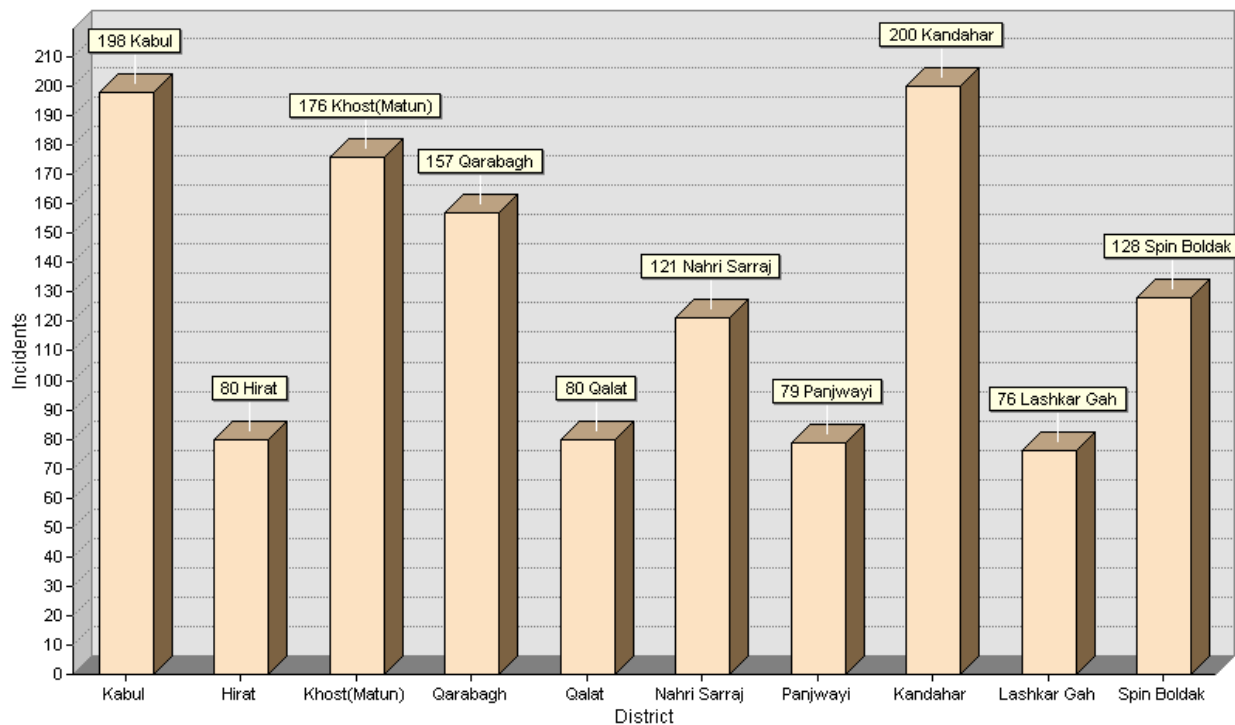
A close-up of southeastern Afghanistan (shown below) indicates that an overwhelming majority of incidents occurred in population centers that are on and around the major national highway and adjacent connecting roads.