

Geovisual Analytics for Improvised Explosive Device Incidents

Scope

This poster introduces the **Basic Ordnance Observation Management System**, a prototype application supporting geovisual exploration and analysis of IED incidents. The Basic Ordnance Observational Management System is designed to facilitate spatiotemporal sensemaking of the IED incident dataset maintained by the National Counter Terrorism Center (NCTC) Worldwide Incident Tracking System (WITS). The prototype application is available publicly at <http://www.geovista.psu.edu/BOOMsys/>

Problem Context

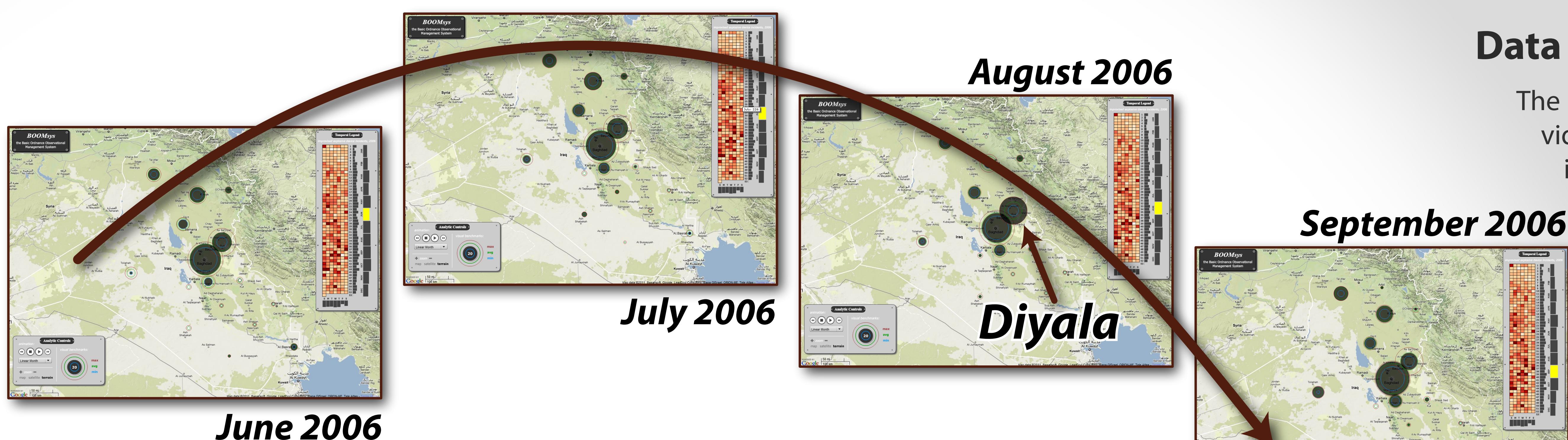
Use of **improvised explosive devices** (IED) by terrorist cells has increased in geographic scale, frequency, and sophistication due to the relative cheap cost of acquiring the materials and the ease in keeping such weaponry covert. IED attacks accounted for approximately 23,000 civilian and military casualties worldwide in 2009 (NCTC 2010) and have become the most consistent and substantial threat to multi-national forces deployed in active operational areas (Castro 2007). A recent report from the United States Government Accountability Office (2009) identified counter-IED shortcomings in several areas, including IED data dissemination, IED spatial analysis, and IED threat analysis.

Visualization Context

Sensemaking describes the process of acquiring and synthesizing information relevant to a given problem, exploring this collection of information to extract insights into patterns, trends, and anomalies characterizing this problem, and presenting these key insights to make informed decisions about how best to respond to the problem (Pirolli & Card 2005). The field of **visual analytics** has been proposed as an area of research and development to investigate how the sensemaking process—particularly the exploration and analysis of large collections of information—can be supported through visual interfaces to computation methods (Thomas et al. 2005).

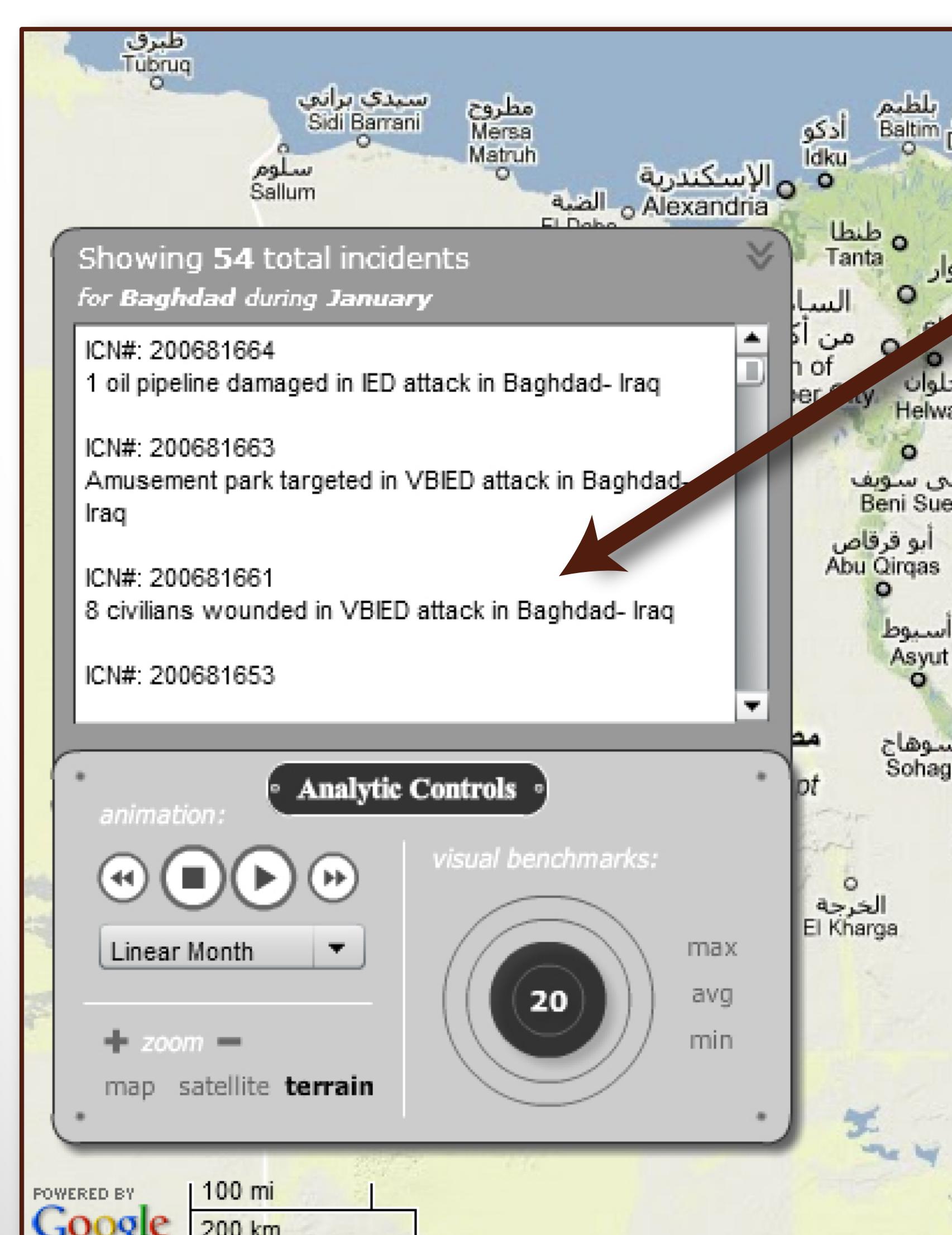
Animation

The user can create and play through four different animation sequences using the Analytic Controls. Users can control the animation using the provided 'VCR' controls or the interactive temporal legend. The above example shows four frames from an animation binning the data linearly by month. The animation shows that Diyala peaked in August, while most other locations lagged behind, peaking instead in September.



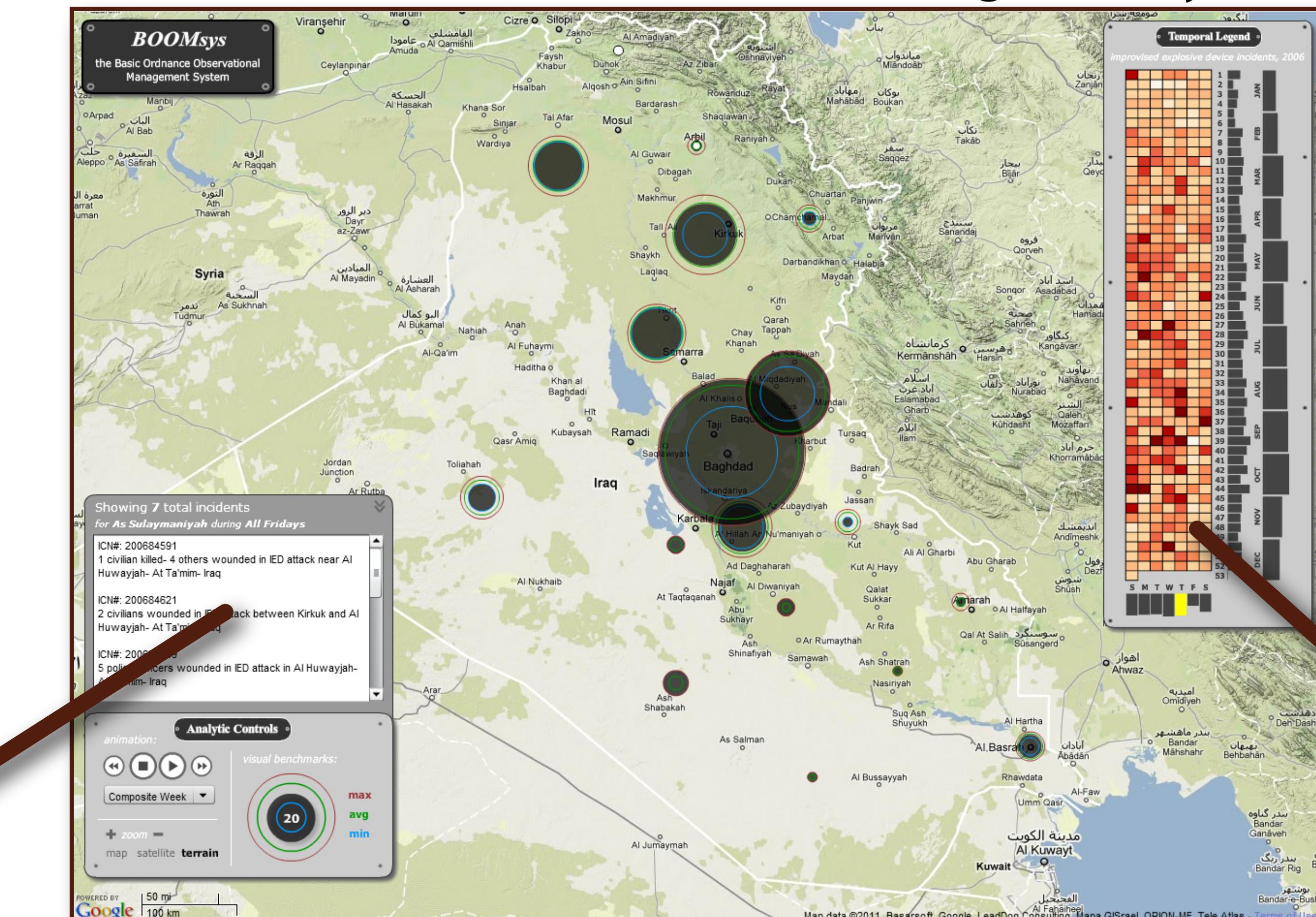
Analytic Controls

The Analytic Controls panel allows the analyst to toggle among three linear sequences varying by the binning unit, or temporal interval used for the flexible aggregation: (1) linear aggregation by day, producing 365 bins; (2) linear aggregation by week, producing 53 bins due to partial weeks at the end of 2006; and (3) linear aggregation by month, producing 12 bins. The analyst also can focus upon cyclical patterns by generating a composite sequence of average day by week, resulting in 7 bins. The Analytic Controls panel provides tools to control map browsing, map animation, and visual benchmarks. The records list is populated once the analyst submits a spatial query (by selecting a proportional symbol) or temporal query (by selecting a bin in the temporal legend).



All Fridays
2006

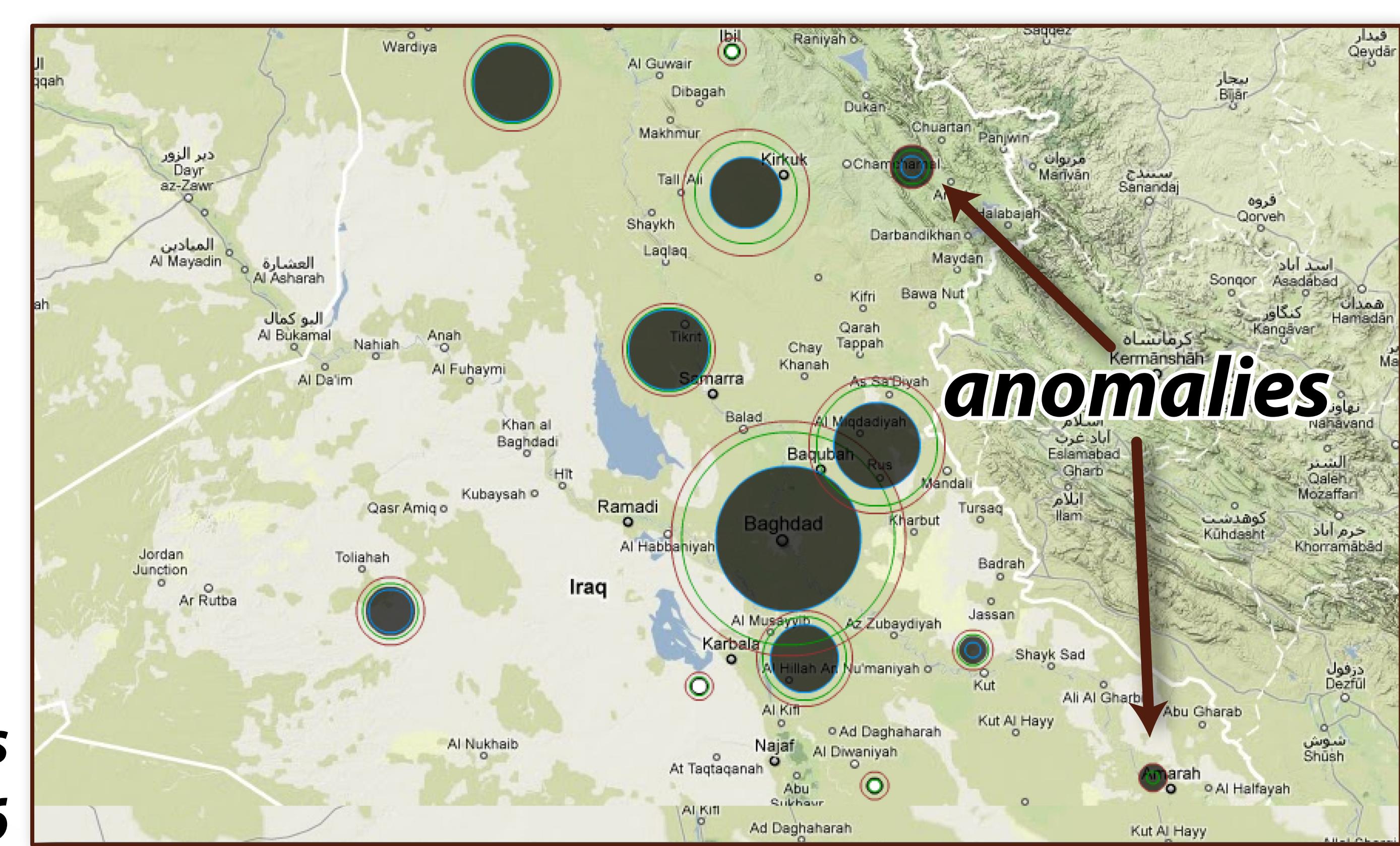
The Basic Ordnance Observational Management System



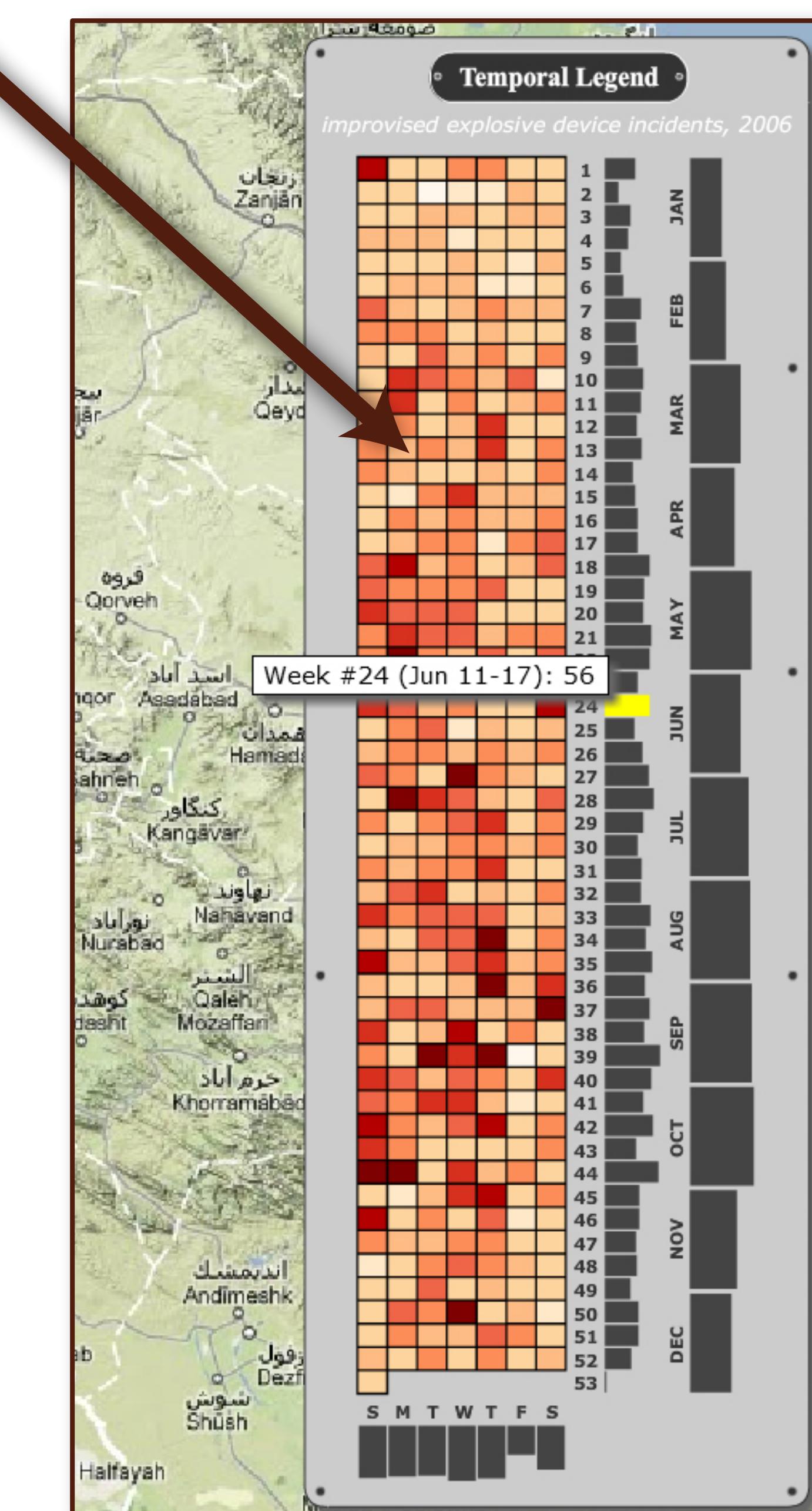
visit this application at: <http://www.geovista.psu.edu/BOOMsys/>

Visual Benchmarks

The analyst can add static visual benchmark rings around the dynamic proportional symbols that depict the frequency in the minimum bin (i.e., the trough) and maximum bins (i.e., the peak), as well as the average frequency across all bins. In the below image shows that, for most locations, the least number of IED incidents are observed on Fridays, excepting the anomalies Al Sulaymaniyah and Al Basrah.



anomalies



Data

The National Counterterrorism Center WITS database provides contextual information for each IED incident, including incident type, ordnance/weapon type, location, date/time, number of victims wounded/killed, and a summary report. For demonstrative purposes, the complete dataset has been constrained to only those incidents occurring in Iraq during 2006, producing a reduced subset of 2,367 records. The IED dataset is loaded into the application at run-time and flexibly aggregated to provide overview visualizations in both space and time.

Application Description

The application expands upon existing geovisual analytics tools for understanding patterns, trends, and anomalies in IED activity through provision of **flexible spatial and temporal aggregates** of the IED dataset; linked spatial, temporal, and attribute views of the incident information; **temporal re-expression**, particularly the generation of linear and composite sequences of the IED dataset; and **map animation** across IED activity, with 'VCR' controls and an interactive temporal legend to control the animation as well as **visual benchmarks** to assist with interpretation of the animation. Specific features are demonstrated in the central graphics.

Outlook

Future work includes increasing the analytical capabilities of the prototype application as well as scaling the system to a larger geographic and temporal extent. We also expect to perform user studies with domain experts in order to refine and extend the system to better support the sensemaking needs of the targeted end users.

Acknowledgements

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