

# Templating an Adaptive Threat

## Spatial Forecasting in Operations Enduring Freedom and Iraqi Freedom

By Lieutenant Colonel Stephen R. Riese

Our adaptive adversaries in Afghanistan and Iraq continually challenge our ability to forecast future enemy activity and develop tactical plans. To meet these challenges, commanders and staffs need new tools that take advantage of the vast amount of information available to our troops.

The past decade has seen geographic information systems (GIS) move into the mainstream of tactical analysis. GIS are powerful tools that enable Soldiers in the field to collect, store, and analyze spatial information. Spatial information—where things are in relation to other things—has been a critical part of military planning as long as there has been war. And since almost every aspect of military operations has a spatial component, the range of potential GIS applications is almost endless.

One activity that GIS are particularly well-suited to help with is spatial-pattern recognition. Because GIS can make thousands or millions of distance calculations in minutes, analysts can now uncover and exploit patterns that might otherwise remain hidden. As seen in Figure 1, spatial patterns are present in many types of human behavior regardless of the scale. The unaided human eye can detect these patterns and groupings, but it usually requires the power of computers to help the analyst turn those patterns into tactically useful information.

### Threat Mapper

In May 2004, the Army asked the United States Army Training and Doctrine Command (TRADOC) Analysis Center (TRAC) to assess the potential that spatial analysis provides in forecasting the locations of future mortar attacks. The initial results were quite promising, and TRAC—in

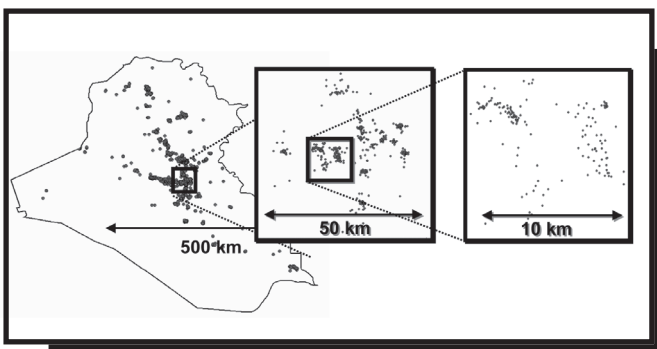


Figure 1. Patterns at various scales

collaboration with the Engineer Research and Development Center–Topographic Engineering Center (ERDC-TEC)—began the development of *Threat Mapper*, a computer program to help analysts in the field make spatial forecasts in support of tactical intelligence operations.

Threat Mapper is designed for use at the tactical level, although it can be used at any echelon. Soldiers can use Threat Mapper to help with a variety of spatial forecasting and identification problems such as mortar attacks, weapons caches, and safe houses. Threat Mapper uses advanced pattern analysis techniques to measure the spatial similarity between an area of interest and an observed behavior. The results of that measurement are presented to the analyst in a threat map, which helps the staff build a more informed intelligence estimate and better plan intelligence, surveillance, and reconnaissance (ISR) and tactical operations (see Figure 2). Threat Mapper helps analysts recognize and adapt to changes in adversary behavior, even when that adversary is actively trying to appear random.

Threat Mapper currently functions as an add-in tool for ArcGIS, a commercially available GIS. ERDC-TEC's future plans for Threat Mapper include a Web-enabled version, as well as integrating spatial-forecasting methods into current and planned Army geospatial programs.

### Tactical Forecasting

To illustrate how Threat Mapper can be used in the field, we built a simple threat map for an area that has had numerous mortar attacks. Figure 3 shows forward operating bases, roads, rivers, and the attacks that occurred in the area. These mortar attacks are the behavior of interest, meaning that the threat map will help us identify other locations probable for such attacks.

We first selected the features on which to measure spatial similarity. In reality, there is an almost endless list of spatial features, such as roads, buildings, and forests. In most cases, knowing which spatial feature to use is the most important and challenging task facing the analyst. Threat Mapper has several tools to help Soldiers determine the best set of features, but—as usual—experience, knowledge, and hard work are the best ingredients to build a successful intelligence product. Using the Threat Mapper tools, and a little trial-and-error, we will find a set of useful features.



Figure 2. Threat Mapper application from enemy behavior to threat map to tactical plan



Figure 3. History of mortar attacks

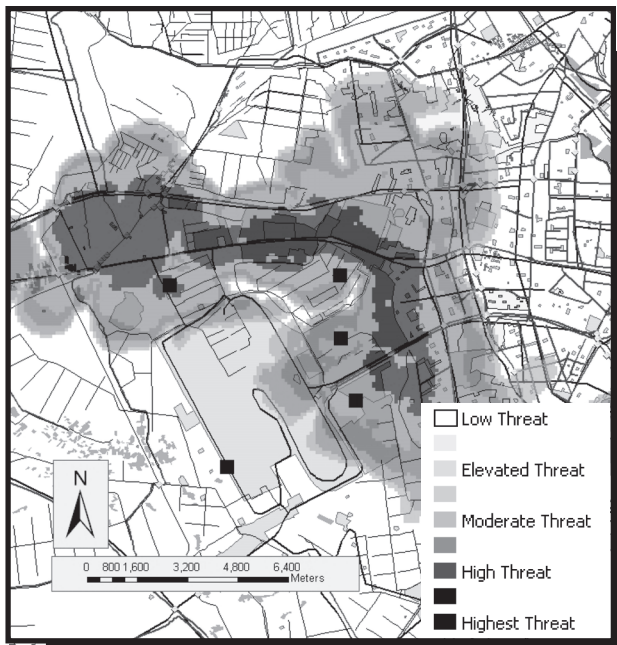


Figure 4. Example threat map with scale

One way to help measure the threat map’s accuracy, is to see how well the map forecasts future behavior. In real life, new attacks would tell us if the threat map is a good forecaster or not. Here, we will use the recent historical attacks to play the analytic role of new attacks. To do this, Threat Mapper splits the data, using the early attacks to build or train the threat map and the recent attacks to check or test the accuracy of the threat map. After providing Threat Mapper more details about the data and requirements for the desired map output, the analyst hits the “go” button and lets the GIS go to work. The result is the printed map in Figure 1.

### The Road Ahead

The Threat Mapper tool is currently developed as a deployable package in beta form. It has been tested in a variety of situations by the military, academia, and government. Recently, a team led by the ERDC Cold Regions Research and Engineering Laboratory (CRREL) trained Army geospatial and intelligence analysts on a suite of deployable tools, including Threat Mapper. The analysts’ training with these tools will provide valuable feedback to Threat Mapper developers at ERDC-TEC and CRREL.

### Conclusion

A word of caution: There is a great deal of uncertainty about when and where the next attack, of any kind, will occur. Threat Mapper can help analysts in the field build a more informed intelligence estimate, but no tool can yet predict exactly when and where the next attack will be. Also, Threat Mapper will not replace Soldier analysts in the field. What Threat Mapper will do is provide analysts in the field with a powerful spatial-forecasting tool to help them better analyze threat activity and thereby gain an information edge against the adaptive enemy.

*Lieutenant Colonel Riese is a combat engineer and operations research analyst with the United States Strategic Command at Offutt Air Force Base, Nebraska. He has worked with maps and spatial analysis in one form or another for most of his life.*