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- Tele Atlas
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- Handheld Nautiz X7 Review

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GEOInformatics

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Sustaining Member

Where's the end user?

Looking at the table of contents of this issue of GeoInformatics, I count a large number of user stories. I'm happy to notice this, because sometimes it seems to me that the end user is not given that much attention. It's easy to mention all the new features of new hardware and software products, but in the end, someone has to use them. Similar thoughts occurred to me when taking a software course last month. Before the course started, the trainer asked what the participants wanted to learn and for what specific tasks they thought they would use the software. I was surprised to learn that everybody in the room had completely different ideas of how to use this particular software. In other words, every user had a different story to tell.

The course was quite an enlightening experience. Not only was it useful to have some hands-on training as a writer, but I also realized that challenges can arise where you don't expect them. I found myself editing GPS files in Notepad for the first time in my life, and I noticed what happens if you are suddenly dependent on how other people capture and store data. It's as if you're going to cook with excellent cooking equipment but the ingredients are bad (ingredients = data, cooking equipment= software), or you don't know what the ingredients are because you can't read what's written on the label. Although data validation wasn't part of the course, it was good to see what it's like to work with good data.

Back to this issue, you will find a great deal of user stories, working with all kinds of data. Particular attention is paid to LiDAR data in a number of articles. Another article I'd like to mention is about tile caching and how to do this more efficiently in the future, since imagery volumes are getting bigger and bigger. I hope the articles in this issue will be of value in your daily work or inspire you in the future.

Enjoy your reading!

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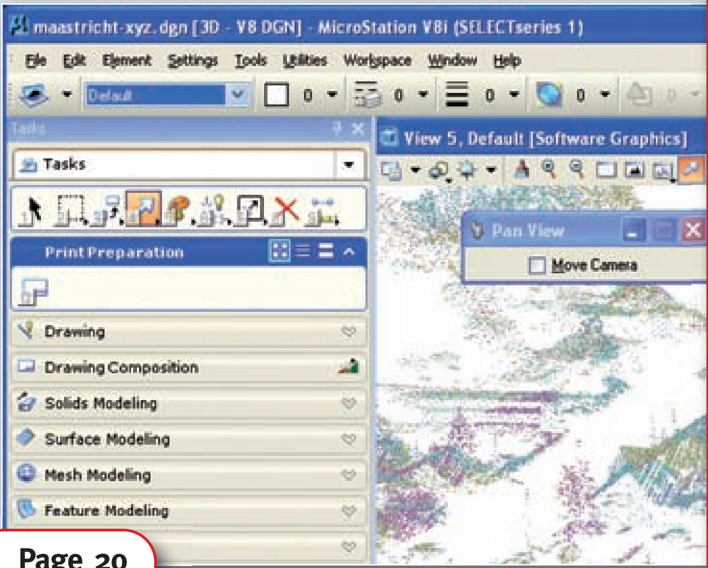

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Bentley Systems and 3D GIS

The release of Bentley's V8i (SELECTseries1) offers a series of new functionalities involving 3D GIS. Gijsbert Noordam, Senior Consultant, Geospatial Center of Excellence at Bentley Systems, explains the possiblities of 3D City GIS, the recent cooperation between Safe Software and Bentley Systems, and the potential of object oriented data acquisition and the use of point cloud data.

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The Resurs-DK1 Satellite

Although the Resurs-DK1 satellite has been in operation for over three years, its operations and its imagery are not well known outside Russia and the CIS countries. Nevertheless an archive of 14,000 very high-resolution images with substantial world-wide coverage has been built up; the satellite is still in active operation; and the imagery is less expensive than that of its commercial competitors. Furthermore two new Resurs-P satellites are being developed that will follow on from the successful Resurs-DK1 and will offer additional improved coverage.

Content

The Austrian Criminal Intelligence Service

GIS, Spatial Analysis and Public Safety

This article discusses the visualization and modeling strategies of crime investigations at the Austrian Criminal Intelligence Service. GIS and spatial analysis are effectively used in their day-to-day operations, for instance for visualization purposes of crime hot spots, crime prevention activities and resource allocation. By some examples the practical application is shown and clarifies the additional benefit of this new technology in crime prevention.

By Marco Helbich and Karin Kampitsch

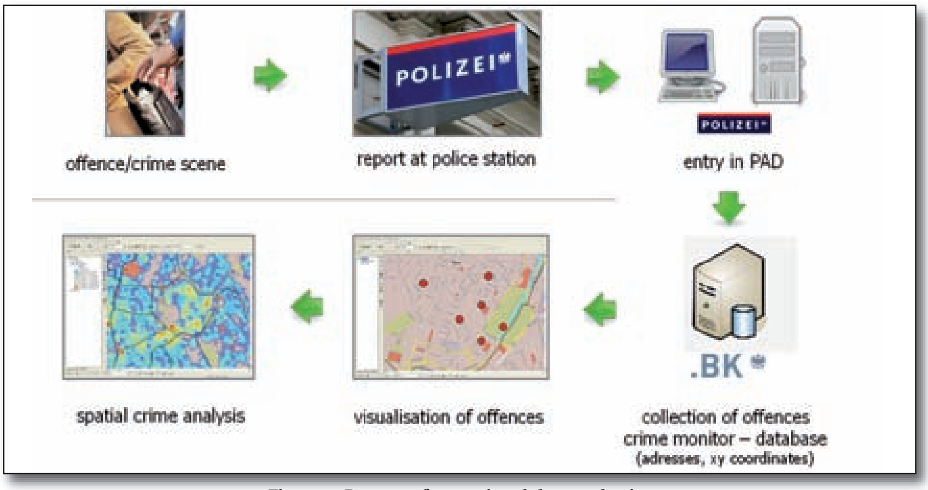

Figure 1. Process of operational data gathering

Background

In 2009 nearly 592.000 crime investigations were perpetrated in Austria. Compared to the year 2008 the amount of criminal offense increased approximately about 3,3 percent, whereas solved offenses have been reduced about 7,4 percent. To counteract such a trend, crime agencies revert to modern technologies. Nowadays, geographic information systems (GIS) and spatial analysis are valuable tools and effectively used in day-to-day operations of governmental agencies. This is also true of police departments, which increasingly supplement and enhance traditional criminological modus operandi with geo-technologies for tactical and strategic decision-making.

Contrary to the U.S., where crime mapping and analysis have a long and successful history reaching back to the 1980s and are commonplace in law enforcement agencies, in Austria it is a novel and emerging research theme and field of application. GIS as an exploratory analysis tool improved the ability to gain knowledge from the data to understand the spatial and social processes contributing to the presence or absence of criminal offenses. This article discusses the development of the Austrian Criminal Intelligence System (ACIS) as a case study and their application of GIS technology and spatial modeling methodologies.

Establishment of the Austrian Criminal Intelligence System

Crime is a spatially heterogeneous distributed phenomenon, meaning that certain areas are more likely to exhibit some criminal activities than others. Because place matters, geoinformation technologies play a key role in mapping and analysis processes and serve as basis for decision-making. This fact was recognized at the Federal Ministry of the Interior in 2002 and the ACIS was launched. Their aspired main objectives were twofold: First of all, the department should apply high international standards and methodologies presented in the literature. Secondly, GIS should be nationwide implemented and should help visualizing criminal situations, and support the daily work of the 27.000 Austrian police officers in the field by providing up to date information about crime occurrences, for planning their patrols and so forth.

During the start-up phase the German GIS project of the police headquarter of Munich (Germany) served as a prototype. It was one of the first crime mapping projects in German speaking countries, respectively in Europe. The funding of the ACIS was primarily originated from the "security billion" to improve the human and technical resources of the executive. The money placed at the disposal was obtained to recruit some experts and to buy GIS technology. Recently, the department consists of an interdisciplinary team of three executives with some geoinformatics and crime jurisprudence background. For analysis and mapping purposes proprietary ESRI products like ArcGIS 9.x and ArcGIS Server became their software of choice. As data base technology Microsoft Access and Microsoft SQL-Server are in use. Additionally, for the analysis and modeling of crime incident locations the freely distributed CrimeStat III software by Ned Levine and Associates is used.

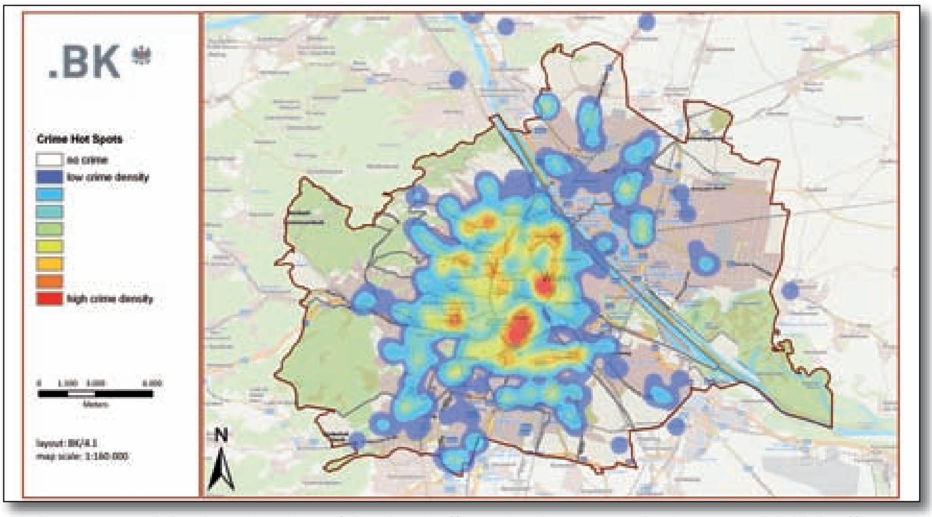

Figure 2. Kernel density estimation of simulated offenses in Vienna. In red color areas with high offenses.

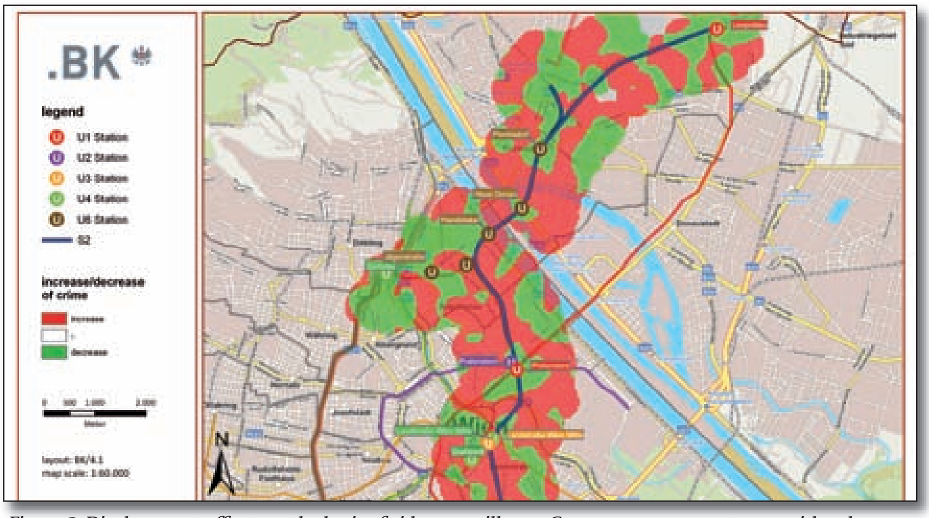

Figure 3. Displacement effects on the basis of video surveillance. Green areas represent areas with a decrease and red areas represent an increase of crime.

From Crime Locations to Database Entries

Figure 1 illustrates the operational data gathering process. Every time a crime investigation takes place, it is reported to a police station. On the basis of this testimony the police officer inserts the facts (e.g. kind of crime act, time, address) in the Police Information System (PAD). Offenses of criminal relevance are stored in the crime monitor database operated by the department of criminal analysis. The geocoding process is carried out aligning the address of the crime scene with the Austrian central inhabitants register. Henceforth, the criminal data can be retrieved from the database and are available for various types of further spatial analysis, of which some are introduced in the following section.

Because crime is affected by variations of demographics, the built environment and other social aspects, an abundance of data and cartographic material is necessary for crime mapping and analysis as well. Thus, supplementing the operational data, a considerable part of seed money was spent for an additional geographical database, containing street data as well as points-of-interests (e.g. gas stations, banks) distributed by Tele Atlas, socio-economic data distributed by Statistics Austria and miscellaneous remote sensing scenes and areal pictures.

Spatial Analysis Tools for Understanding and Mapping of Crime

Spatial analysis can be used for strategic and operational applications. Strategic GIS applications are, for instance, the representation of local crime situations, the detection of spatial displacement effects, or the analysis of video-monitored areas. On the contrary, operational GIS applications include the analysis of offender groups, calling and positioning data, as well as support for task forces. This section presents some analysis and mapping techniques beyond traditional geoprocessing tasks (e.g. spatial queries, buffer analysis) recently used at the

ACIS to detect hot spots of crime investigations. Following Eck et al. (2005) hot spots are (local) areas with a high crime density or, in other words, areas where people have an above average risk of victimization. Knowing such past locations helps to act preventatively. Thus, knowledge in state of the art (descriptive or predictive) models and mapping techniques are essential.

Mapping of Crime Situations

Nowadays dotmaps supersede traditional pin maps, but they do not solve the problems of readability caused by multiple points on one location. Therefore an appropriate method to indentify crime hotspots is the kernel density estimation, which is a kind of interpolation technique to convert the discrete points to a smoothed generalized continuous surface over the study site. The surface represents relative densities, absolute densities or probabilities of crime incidence. The results can be visualized as ordinary map, three dimensional plot, and contour map. Figure 2 illustrates the application of the kernel density routine using simulated crime incidents in Vienna (Austria). Because of data protection laws the use of real-world data in this paper is prohibited. The surface shows two peaks of high offences (colored in red). One is located in the inner district and the second, but less distinctive hot spot can be localized in the fourth district in Vienna. High crime densities are also locatable along the main intra-urban traffic axis (Gürtel). This example clarifies the easy interpretability and explanatory power of such maps, as crime hot spot identifiers.

Visualization of Displacement Effects

The cut-and-fill analysis is based on kernel density estimations as well and aims at visualizing an increase or decrease in criminal activities in a target area. To this end, two density maps relating to the same offense but to different time periods, are compared. The resulting map shows the geographic displacement of crime within a determined period before and after a specific campaign. Figure 3, another fictive example, presents drug-related crime along the rapid transit line S2 in Vienna. In this case one period before fixing a video surveillance at the underground stations is compared with a period after the installation of such a system. The map indicates a geographic shift of drug-related crime from the underground stations to areas in between the stations and remote areas. As can be seen, video surveillance operations decrease crime (green areas) but lead to an increase (red areas) elsewhere in the neighborhood.

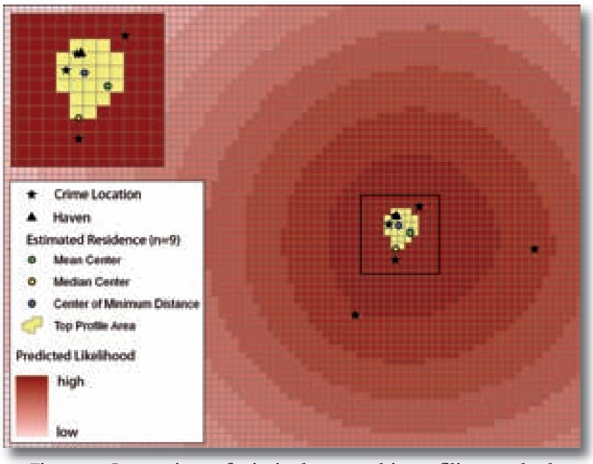

Figure 4. Comparison of criminal geographic profiling methods

Tracking Analysis

This kind of analysis helps to visualize complex spatial time series data and is used for representing situations, where the emphasis lies on the temporal aspect of the operational data. The ACIS uses the tracking analysis primarily for bearing and call data. Bearings are carried out through a global positioning system receiver, which is, for example, attached to suspicious target vehicles for tracing the route it takes. This route can be visualized as an animation or map representing different time stamps. Based on this data it is for example possible to assign some committed offenses in proximate neighborhood of the route to the tracked person.

Estimation of the Offenders Haven

In the near future the ACIS implements and applies criminal geographic profiling techniques to model series of crimes committed by a single offender and to estimate his/her possible haven in consideration of psychological concepts and theories, respectively. For this purpose different methods like for instance the spatial mean, spatial median, and the center of minimum distance exist. An advanced and powerful method is called journey-to-crime. It tries to estimate the haven of a serial offender applying distance decay functions. The potential target area is narrowed down on the basis of a probability raster surface, whereas each cell indicates the likelihood being the haven. Figure 4 shows a fictitious example comparing different geographic profiling techniques. In this case the journey-to-crime approach, whereas the yellow cells possess the highest probability values, and the center of minimum distance (blue dot signature) are the most accurate techniques predicting the real offender's residence (triangular signature).

Crime Atlas Austria - An Overview of Current Crime Events

As an accumulative product of all the mappings a digital crime atlas is published. It is accessible only via the Federal Ministry of the Interior 's intranet, thus not open to the public, and enables any police officer to view a given crime situation in graphical form and to obtain information on GIS applications in the security management area. The provided maps (e.g. dotmaps, choropleth maps, density maps for different types of offenses for different time stamps) are subdivided by federal provinces or themes. The underlying data is updated to the present crime scene in (nearly) real-time. The clients access the crime database with the ESRI ArcReader data viewer and the atlas may serve as a strategic planning tool for decision-making, as it allows detecting serial offenses at a glance.

Future Agenda and Conclusion

Future crucial steps are the development of predictive models and the improvement of their accuracy including spatial and temporal effects (e.g. seasonal variation) for crime-related data. Therefore a close cooperation exists with the Joanneum Research Center (Austria) and scientists from the Louisiana State University (U.S.), respectively, for scientific support. This example emphasizes that GIS and its related methods are an effective way to model and map where, how and why crime occurs. Secondly, the ACIS underpins the successful knowledge diffusion of methodologies from the academic world to public authorities once more.

These tools help to reduce crime and improve the alignment of strategies for prevention. From the scientific point of view it would be preferable if the law enforcement agencies in Europe put their crime maps and data freely accessible on the web as, for instance, the Houston Police Department. Such a rethink could lead to better understanding of crime.

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The text is based on an interview with Mr. Paul Marouschek on January 22 2010. He is head of the, Department 4, Crime Analysis, Austrian Criminal Intelligence Service, Schlickplatz 6, 1090 Vienna, Austria. We would like to thank Mr. Marouschek for his valuable comments and additional materials.