Using Explorative Spatial Analysis to Improve Fire and Rescue Services

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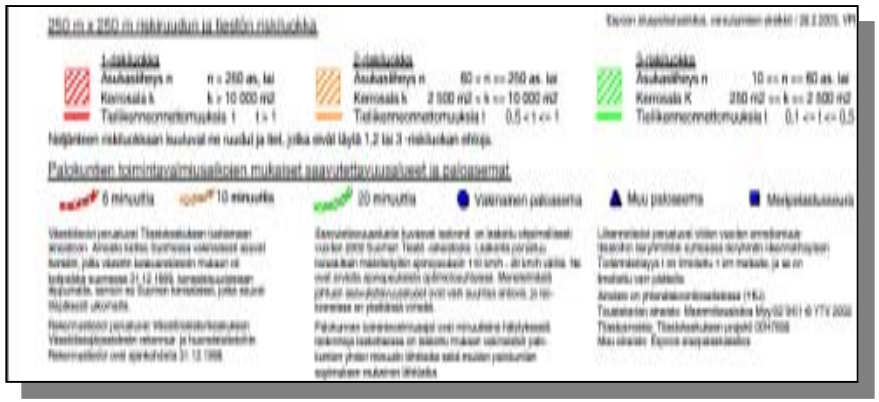
GI4DM - Information Systems for Specific DM Applications

Background

- Municipal risk assesment is a requirement by the Finnish Ministry of Interior 2000 – (Kunnan Pelastustoimen Palvelutasoa Koskevat Päätökset, in Dnro SM-1999-000939/Tu-31)
  - Assist the Fire & Rescue services in their planning and preparation procedures
- Create a risk model for mitigation puposes

Background – Risk model for Espoo county, Finland

- Example from Espoo (Ihamäki, (2000) Geographic information in the planning of rescue services)
  - population data
  - the build-up floor area (in square meters)
  - the average amount of traffic
- These variables are used in an automatic classification routine, which assigns a risk level to each grid cell (four levels)



Scope

- assist the emergency preparedness planning and resource allocation for the fire & rescue services
  - enhance the risk analysis carried out by fire and rescue services
    - What variables are important and how important are they and when (space / time)?
    - Data driven approach
    - Data quality issues
    - Metadata issues
  - provide more informative and appealing (explorative?) maps as tools for decision makers and public participation

Explorative methods

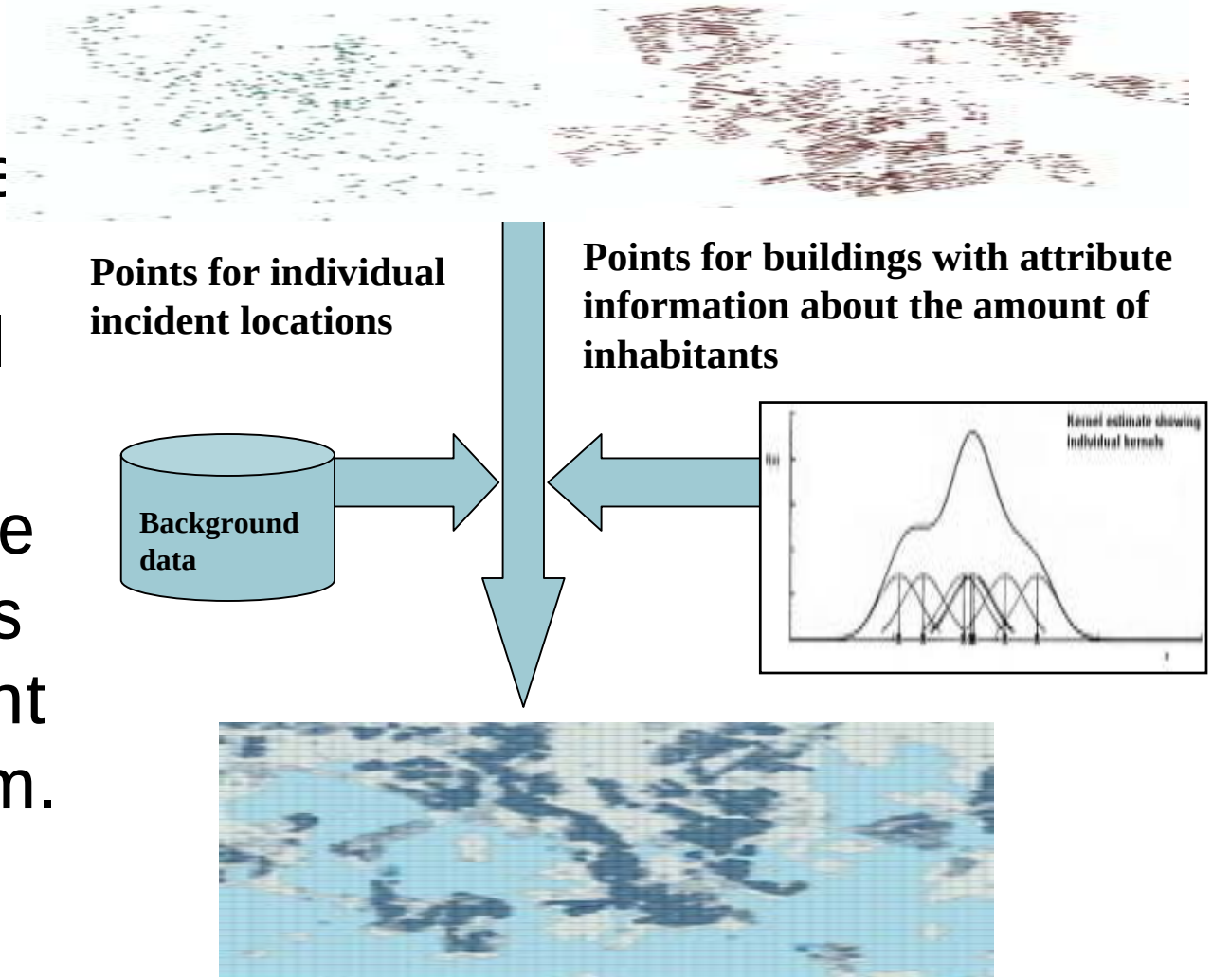
- Explorative visualizations may help
  - finding and evaluating variables for the risk model the spatial
  - determine and value the relationships between variables
- Explorative visualizations may provide more informative and appealing visualizations of the information

Datasets

- SeutuCD by the Helsinki Metropolitan Area Council (YTV)
  - since 1997
  - whole metropolitan area (Helsinki, Vantaa, Kauniainen, Espoo)
  - data package gathered from the municipalities' registers.
- The Helsinki Fire & Rescue department has provided sample datasets, which contains all the fire alarm, rescue missions and also automated fire alarm systems missions within Helsinki city area for the years 2000 - 2003.

Determination of the Population and Incident Densities

- The density of the population and accide incidents can be modeled using kernel density estimation.
- The bandwidth for the population density, as well as for the incident data was set to 100 m.



Significance of Population Density in relation to the Incidents

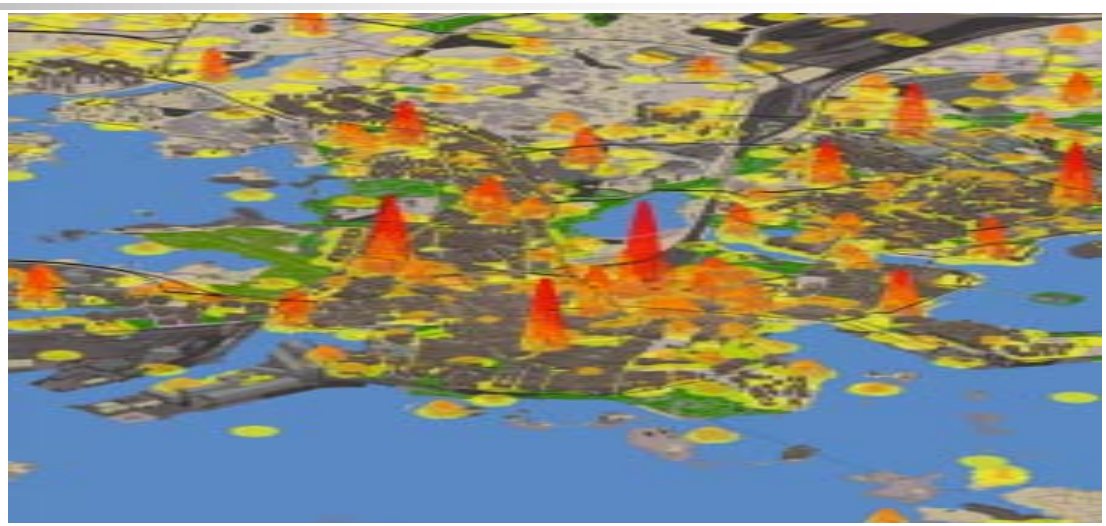
- a scale of 1:20.000
- comparing the to representations visually we can identify that the areas with a high nighttime population density and hot spots for incidents (23:00-7:00)
- high population density do in fact not correspond with areas with a high density

a. Nighttime incident density

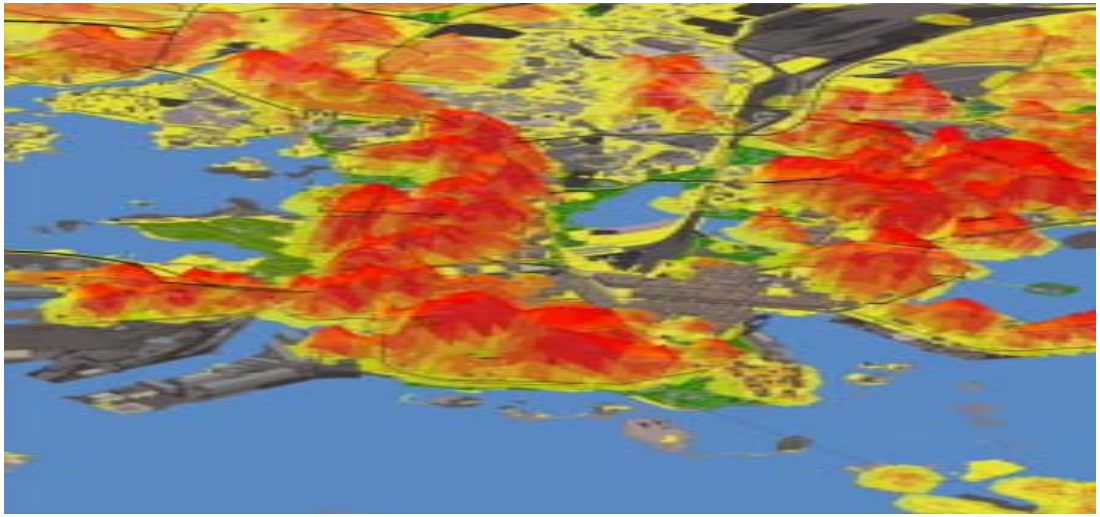
b. Nighttime population density

Visualizing the Incidents Density by Using the Third Dimension

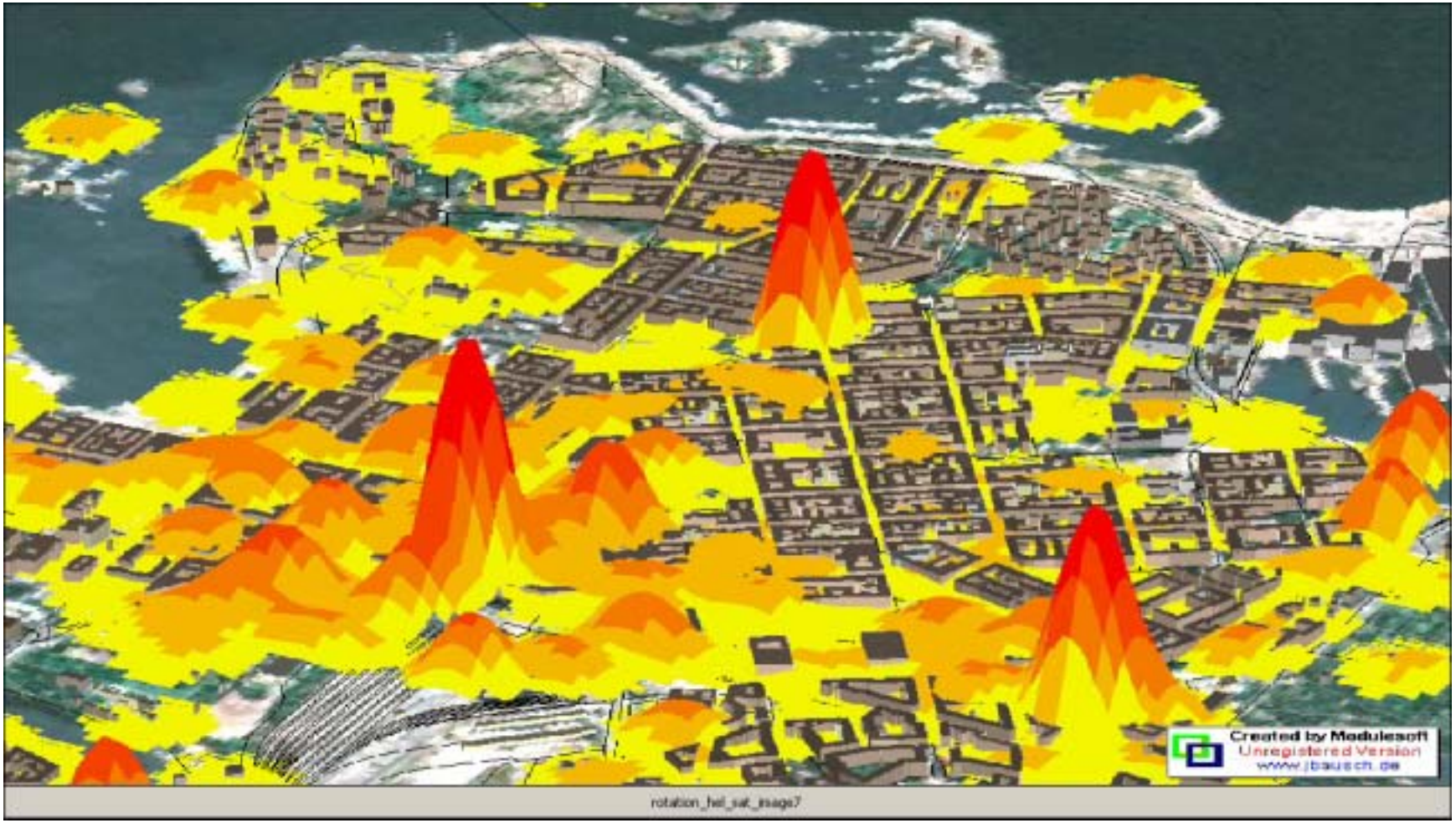
- Incident density (a.)



- Population density (b.)



REM 2005 – ongoing - Visualizing the Incidents Density by Using the Third Dimension



Incident densities over time

- A four-dimensional visualization integrates the density information at each location using a z variable over time.
- We generate three-dimensional maps for all available years (2000-2003) and combine them into an interactive system

Conclusions

- explorative visual analysis may show the significance of a variable in its context for the risk analysis
- visual comparison between the population density data and the incident data shows that the connection between the population density and the incidents reported by fire and rescue services are not as strong as assumed
- Using three-dimensional maps can result in an appealing, maybe flashy visualization. However, the usefulness and usability of these combined three-dimensional maps needs to be proven

Further research

- population density over time (e.g. workplace densities, cell phone data, - Krisp, J. M., Henriksson, R. and Hilbig, A. (2005) Modeling and Visualizing population density for the fire and rescue services in Helsinki, Finland, ICC, A Coruna.)
- to consider individual incidents recorded in the data and the time of each incident
- To visually identify trends by using data over a longer time period
- possible to add the individual risk evaluation for every building into the model
- risk analysis and plans for extreme situations (e.g. war, national crises) can be linked to the “normal” risk analysis

Contact and further information

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- More information on the WebPage
  - **http://www.hut.fi/Units/Cartography/research/rem/index.html**