Geostatistical Approaches for Geovisual Data Exploration, Analysis and 3D Visualisation in Civil Security

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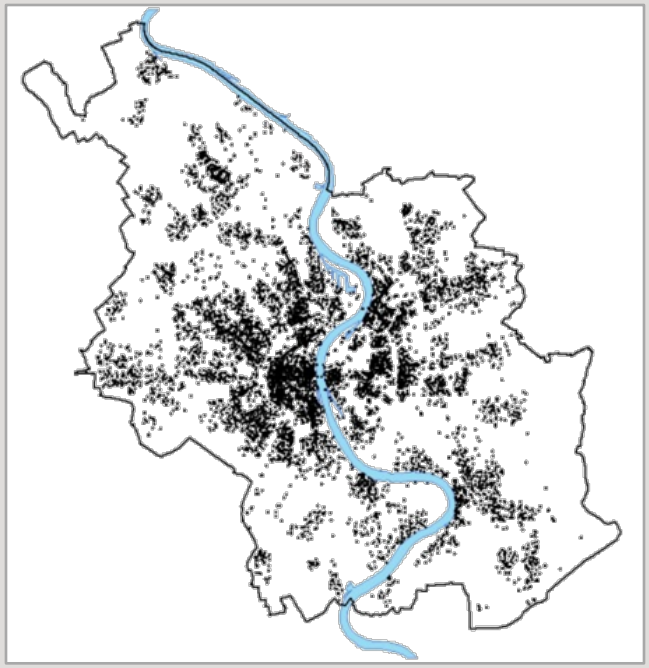
1. Preface and Motivation

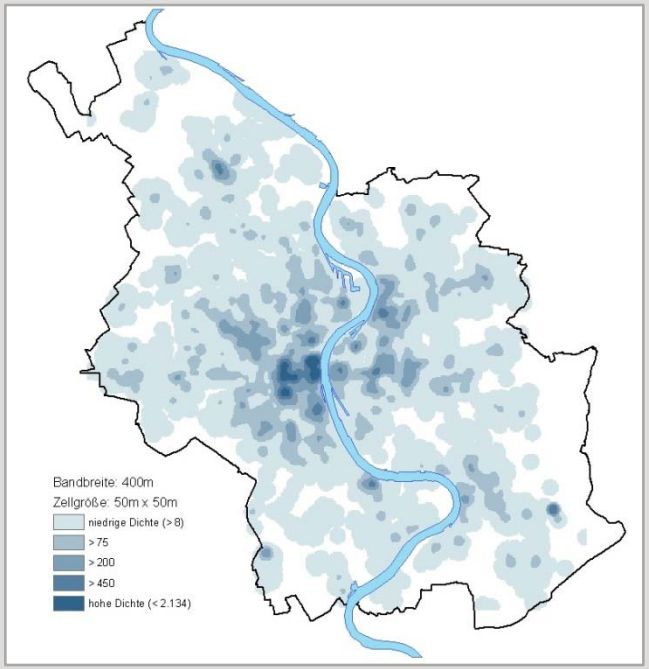
- The fire department of the City of Cologne facilitated a large emergency service dataset that consists of more than 103,000 geocoded features.
- More than 140 different types of emergencies happened during the analysed time period starting in July 2007 and ending in June 2008.
- The majority of the fire departments mass-data is currently not analysed. Knowledge about the spatial and temporal distribution of emergencies was not extracted by now.

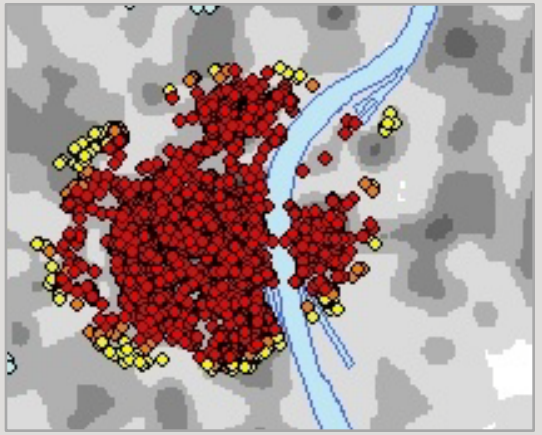
2. Methods for spatio-temporal analysis

- Simple visualisation techniques (point, proportional symbol & grid maps) for a first overview
- Global as well as local statistics are applied for more detailed information about emergency-densities and –distributions in space and time
  - Kernel Density Estimation
    (smooth surface)
  - Getis Ord Gi*
    (identifies hot-/coldspots based on emergency frequencies)
  - Nearest Neighbour Hierarchical Clustering, K-Means
    (encircles the detected hotspots by ellipses)
  - Chi-square test
    (tests the temporal distribution based on time frames)

3. Results [1]

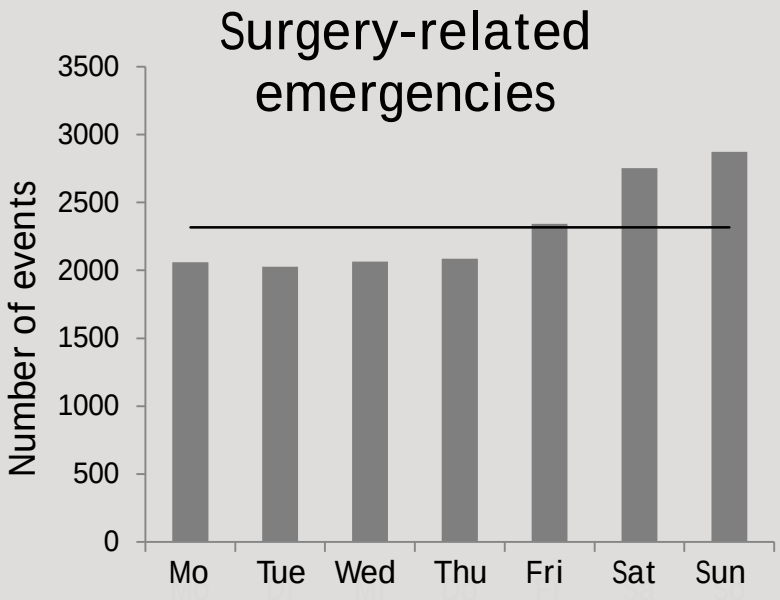






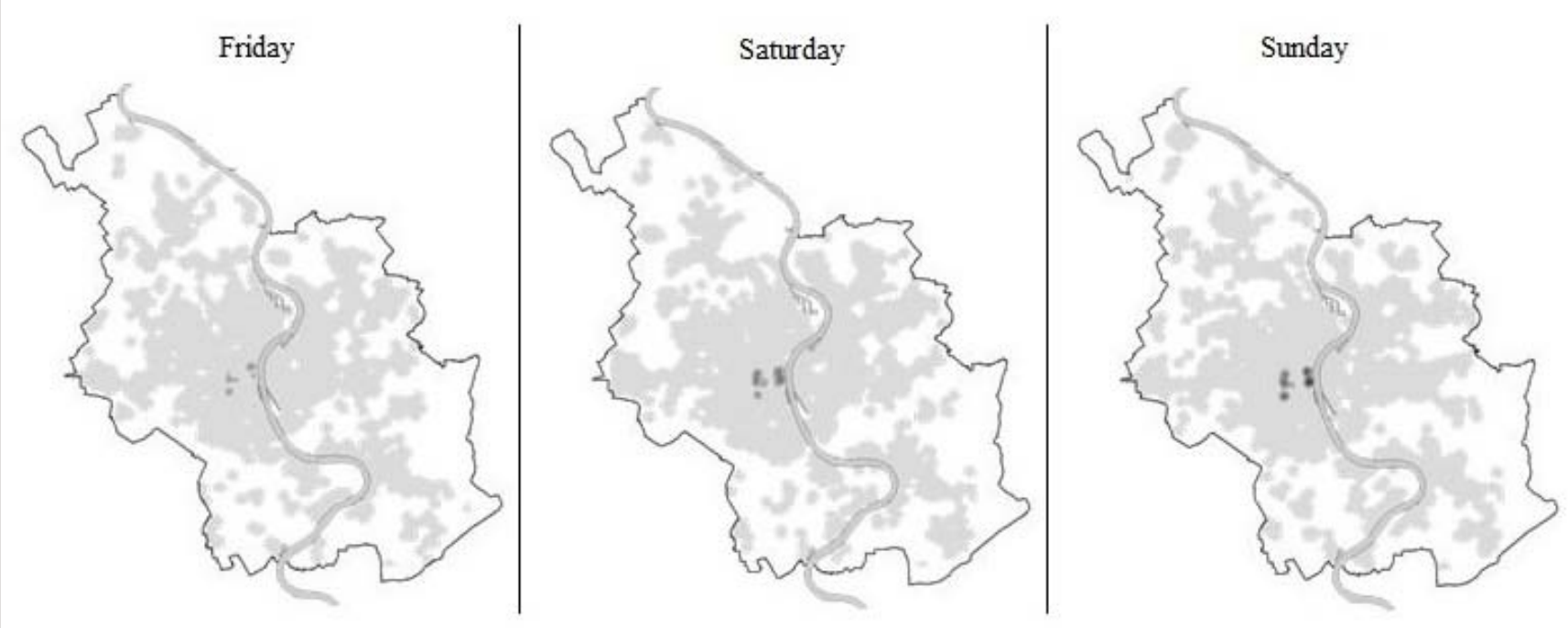
Surgery-related emergencies in the City of Cologne visualised by point maps (left), kde-maps (middle) and Gi*-statistics.

3. Results [2]



Surgery-related emergencies differed by time frames (day of the week).
The observed differences concerning the hypothesis of equal distribution are highly significant.

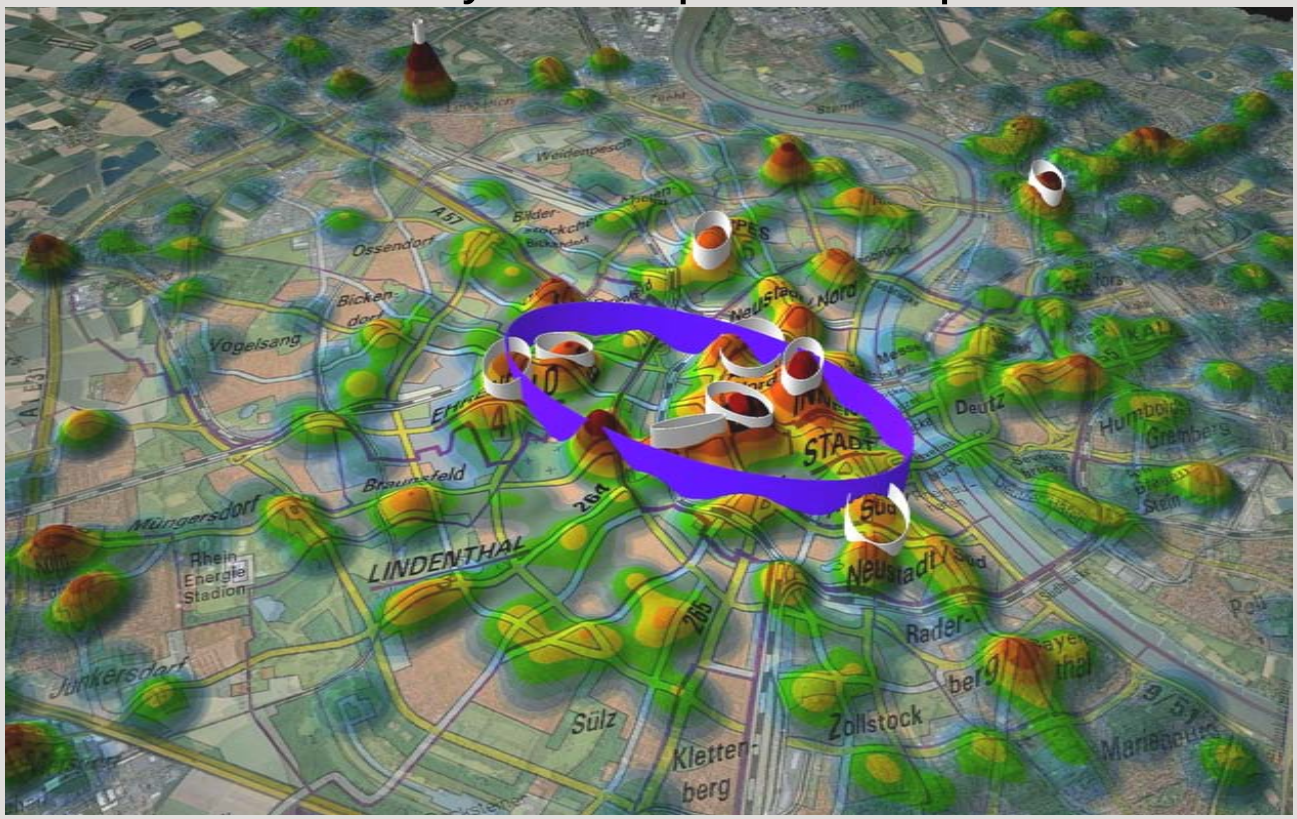
3. Results [3]



According to the selected time frames the surgery-related emergencies show a characteristic spatial distribution: more than 50% of all emergencies happen from Friday to Sunday in the city centre of Cologne.

3. Results [3D VIS]

- Integration of analysis results into a three-dimensional geovirtual environment of the city of Cologne.
- Interactive and easy-to-comprehend representation.



3D kde-surface combined with 3D NNH ellipses

4. Summary

- This contribution presented geostatistical methods for exploring spatio-temporal information from large databases.
- It is shown how specific emergency services cluster in space and time.
- Further investigation: To support geovisual data exploration and analysis a GIS-based application will be programmed that allows an analyst to conduct major analyses without the need of a particular GIS or VIS.

Thank you for your attention!

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