Cartographic Methods for Visualizing the Explosive Remnants of War

Lacroix Pierre

Université de Genève – Institut des Sciences de l’Environnement
GIS consultant for the GICHD
The problem of landmines

> Dozens of millions of landmines worldwide. 70 affected countries

> 2010: 4’191 victims of landmines. 1’155 killed (ICBL 2011)

> 13 states are still potential producer of anti-personnel mines
IMSMA

> Information Management System for Mine Action
> Relational database management system + reporting
> 60 countries
> Data stored as XY pairs + estimated/calculated area
> IMSMA is not a global repository of data
Who are the end users of this research?

1. Donors and the general public
   - $480 in 2009
   - Need a global overview of the contamination to decide which country/area to fund as well as which activity (e.g. landmine clearance, mine risk education etc.)

2. Directors of national MA authorities
   - Need a reliable indicator of the progress of mine action activities to show e.g. to donors
   - Are asking for advanced information technology that is ‘too complex to include in the regular IMSMA’
Who are the end users of this research?

3. Operations officers
   > Small to large prioritization process
     1. Refer to national-regional impact surveys results to decide where to clear
     2. Refer to other data (infrastructures, landcover, slope) to decide how to access the areas

4. Database administrators
   > Probing the database for inaccuracy or incompleteness
   > Work at large scales

> GIS expertise of these users is quite low
State of the art: cartography and GIS in mine action

> Few attempts

> Few contamination maps available on the Web. Not up-to-date, not always interactive, sometimes hardly legible

> One paper on the use of KDE to analyse and cartography landmine risk
  > Single scale
  > Points only
Scientific question

To what extent can GIS improve visualization of contamination?
Data related specificities

> Heterogeneity:

> Updates: few/year (Nicaragua, Zambia) vs thousands/year (Afghanistan)

> Geometry: points > polygons

> Reliability depending on the type

> Few polygons in some programmes

> Completeness of database

> Positional accuracy
User related requirements

> Respecting data privacy
  > Disputed borders should not be visible
  > Exact locations could be used to sell landmines on the black market
  > Protection of civilians

> The method presented here does not address these requirements
  > Each mine ~ one circle
Requirements for visualising explosive remnants of war data

- Requirements are sometimes contradictory
  - Precise enough maps to show contamination
  - Obfuscated enough not to show too much
  - Flexibility. Keep control over the level of detail that users want to show
Methodology

- 6 mapping methods

- Evaluation of each method against previous requirements

- Validation by end-users
Focus on the two kernel methods

> Customization of kernel density estimation bandwidth: Average Distance to K-th Nearest Neighbour

> ... K is adjustable by the end user = parameter allowing users to keep control over the level of detail of maps
Results with the two kernel-based methods

Customized KDE (applied to points) fits better the original patterns

Non customized KDE

Customized KDE (applied to polygons) even better. Local hotspots are shown
Prototype for the KDE-based methods

Selection of data to be visualized

Cursor for end users to define the level of detail of the kernel map
To what extent can GIS improve visualization of contamination?

> To a large extent, provided that a complete cartographic framework be supplied

> Different methods - Different scales - Different user groups

> We explained pros and cons of each method

> **Recommendations** (can be extended/adjusted to users’ specific needs)


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<thead>
<tr>
<th>Target audience</th>
<th>Global level</th>
<th>Sub-continental level</th>
<th>National level</th>
<th>Sub-national level</th>
<th>Municipality level</th>
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<tbody>
<tr>
<td>Users outside the core MA domain</td>
<td>Method E (polygons)</td>
<td>Method E (polygons) Clusters</td>
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<td>Directors of national MA authorities</td>
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<td>Method D (points) Choropleth maps</td>
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<td>One-to-one dot maps</td>
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Thank you