UNIVERSITÉ DE GENÈVE
INSTITUT DES SCIENCES DE L'ENVIRONNEMENT

GICHD | CIDHG

# Cartographic Methods for Visualizing the Explosive Remnants of War


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# 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**

*Source: GICHD 2011*


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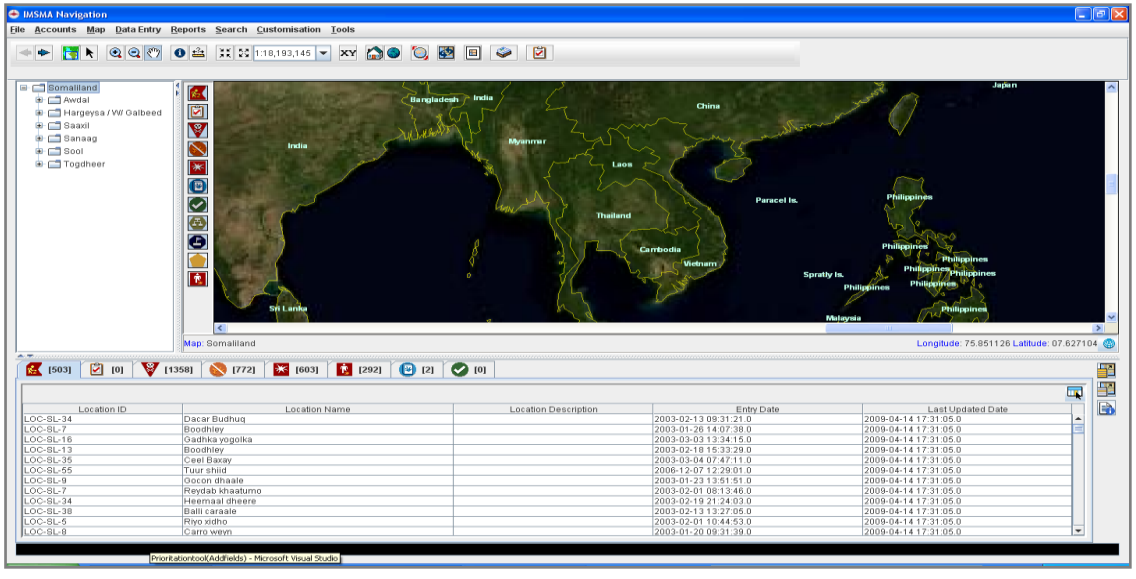
# IMSMA

- 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?

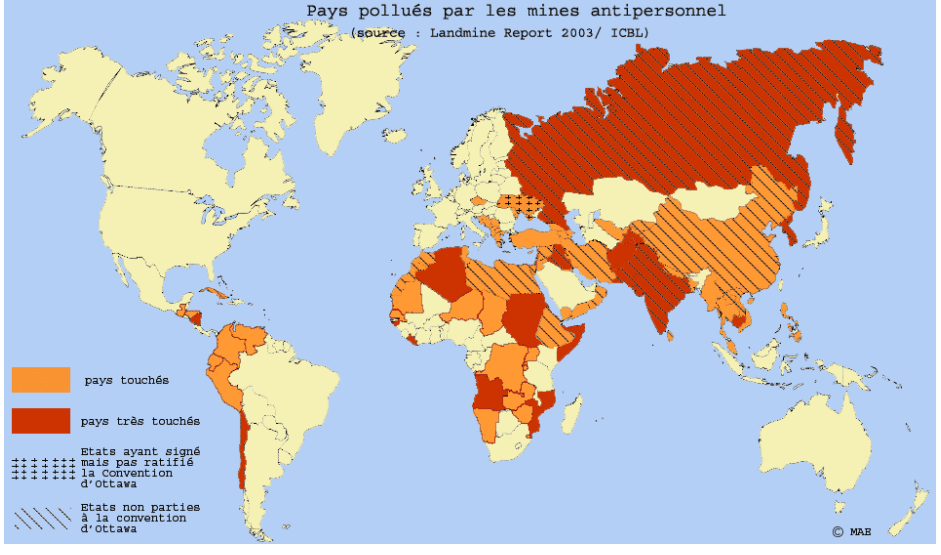
3. **Operations officers**
   - > Small to large prioritization process
     1. Refer to national-regional impact surveys results to decide where to clear
     2. Refer to other data (infrastructures, landcover, slope) to decide how to access the areas

4. **Database administrators**
   - > Probing the database for inacurracy or incompletness
   - > 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

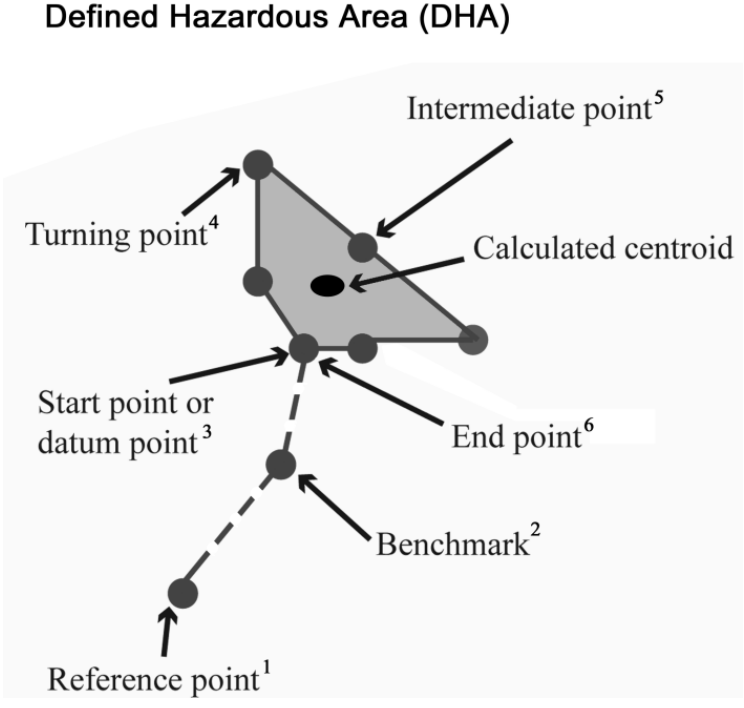


# Scientific question

## To what extent can GIS improve visualization of contamination ?

# Data related specificities

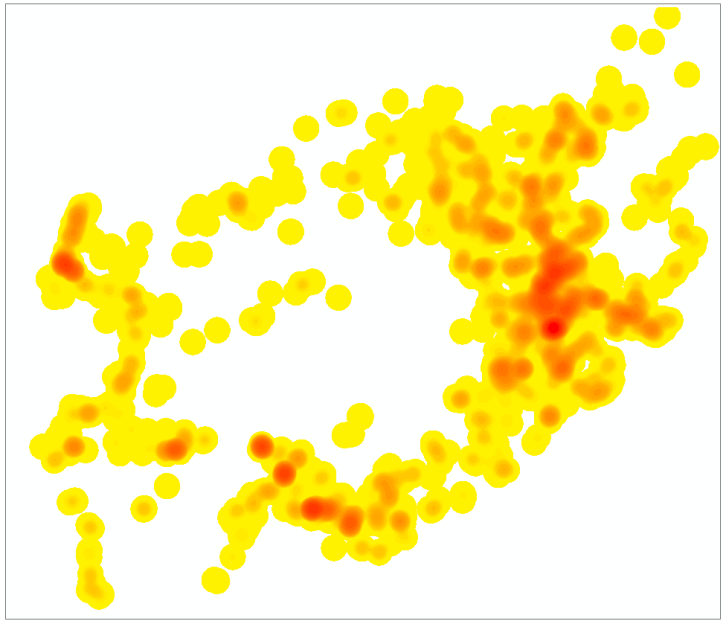
- **Heterogeneity:**
  - **Updates: few/year (Nicaragua, Zambia) vs thousands/year (Afghanistan)**
  - **Geometry: points > polygons**
  - **Reliability depending on the type**
  - **Few polygons in some programmes**
  - **Completeness of database**
  - **Positional accuracy**




# User related requirements

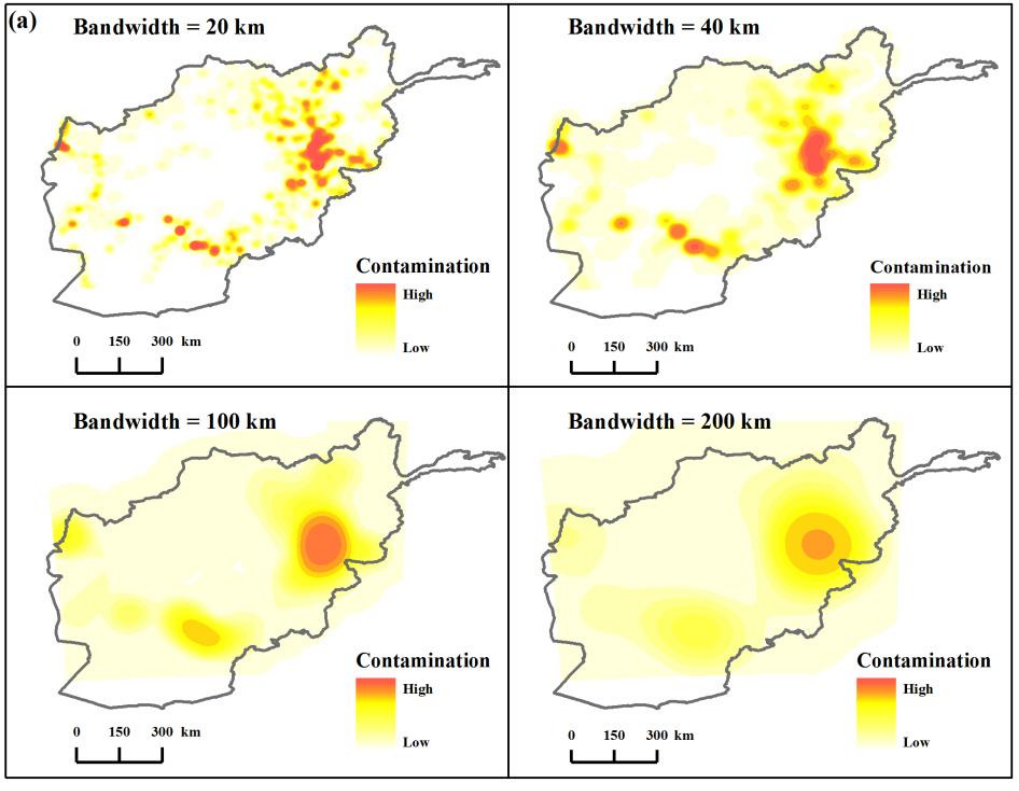
- **Respecting data privacy**
  - Disputed borders should not be visible
  - Exact locations could be used to sell landmines on the black market
  - Protection of civilians

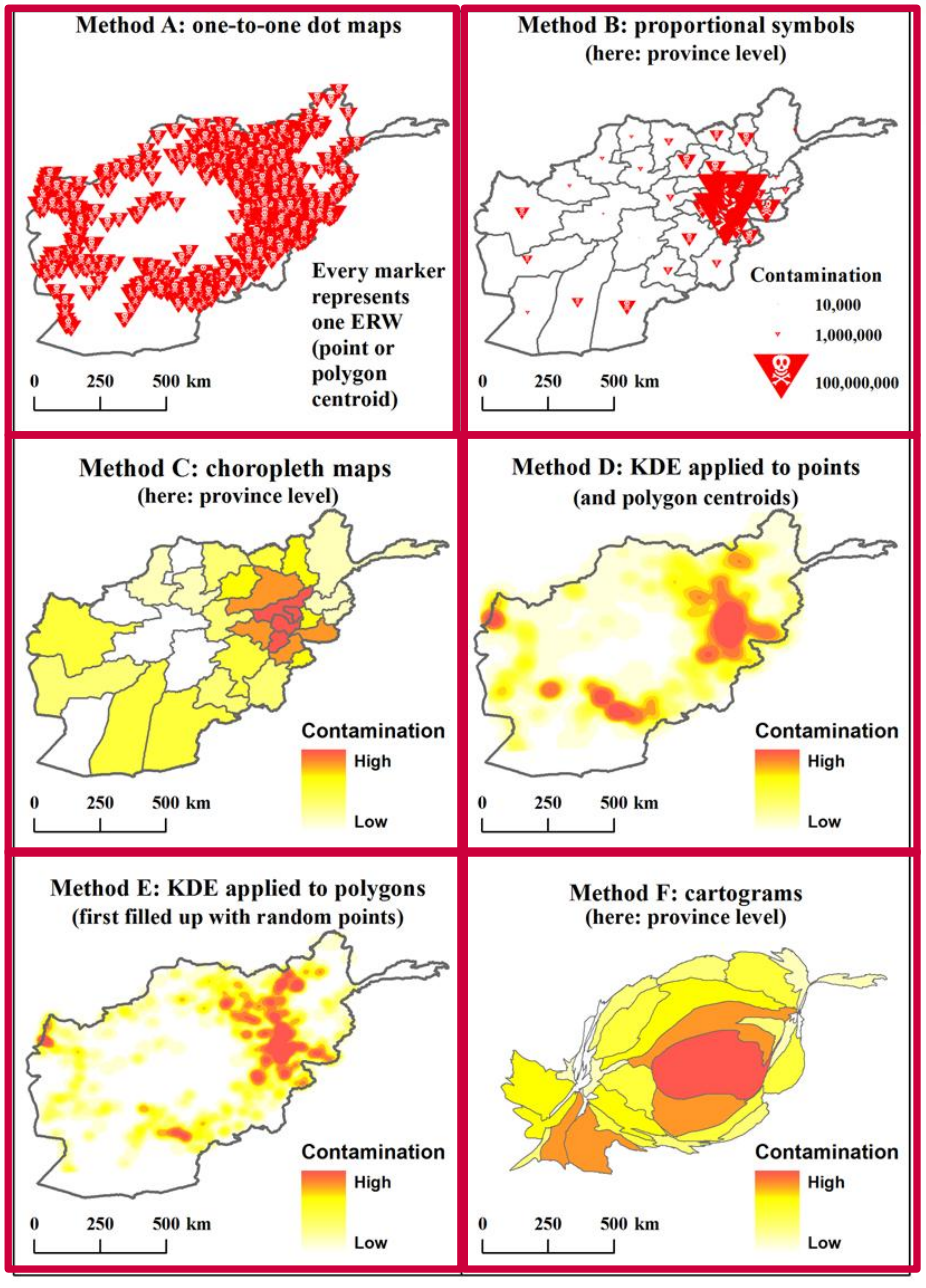
- **The method presented here does not address these requirements**
  - Each mine ~ one circle



# 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

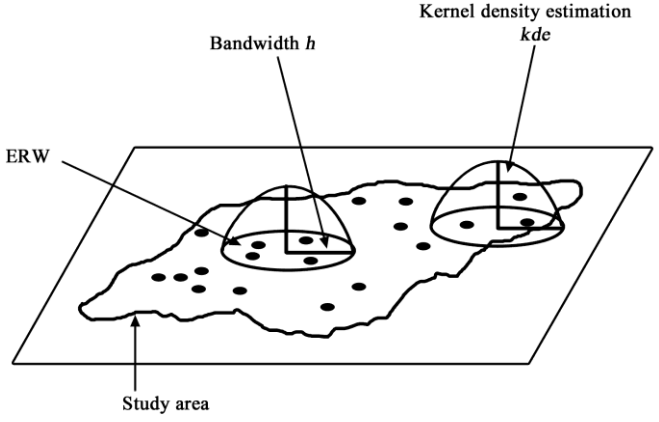
> 6 mapping methods

> Evaluation of each methods 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**

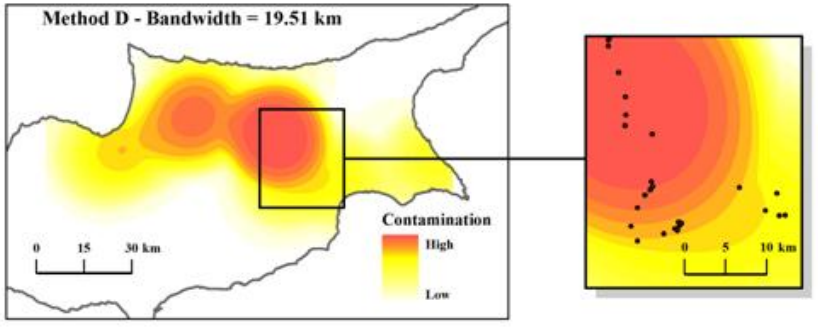



> **… K is adjustable by the end user = parameter allowing users to keep control over the level of detail of maps**

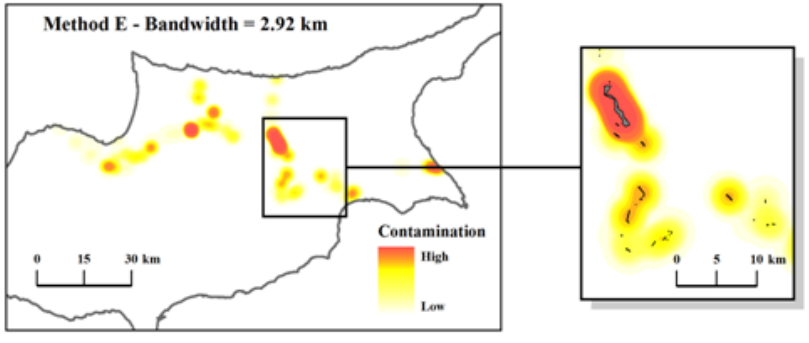
# Results with the two kernel-based methods

## Non customized KDE

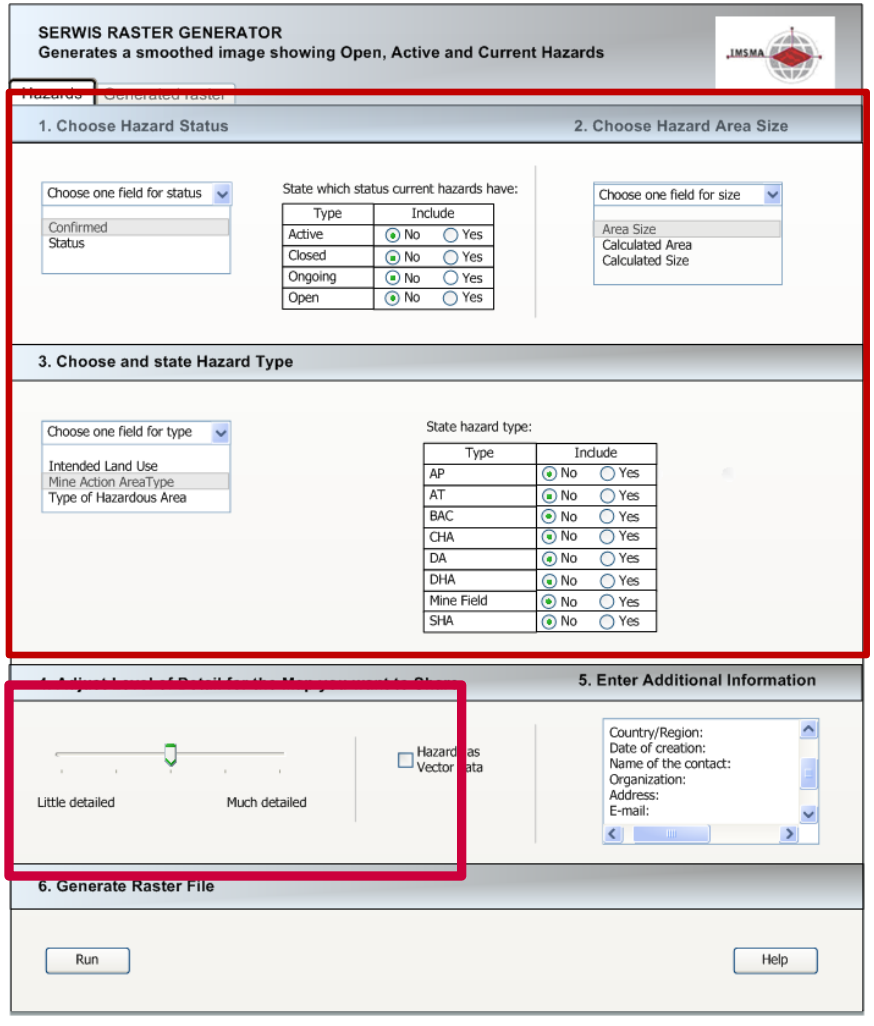
## Customized KDE (applied to points) fits better the original patterns




## 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)**
- **Lacroix, Herzog, Eriksson, Weibel (2013). *Methods for Visualizing the Explosive Remnants of War* – Applied Geography, 41:179-194**

| Target audience | Global level | Sub-continental level | National level | Sub-national level | Municipality level |
|---|---|---|---|---|---|
| Users outside the core MA domain | Method E (polygons) | Method E (polygons)<br>Clusters | | | |
| Directors of national MA authorities | | | Method D (points)<br>Choropleth maps | Method D (points)<br>Choropleth maps | |
| Operations officers | | | Method D (points)<br>Clusters | Method D (points)<br>(Clusters) | One-to-one dot maps |
| Database administrators | | | | | One-to-one dot maps |

# Thank you