Identifying map regions that are difficult to read

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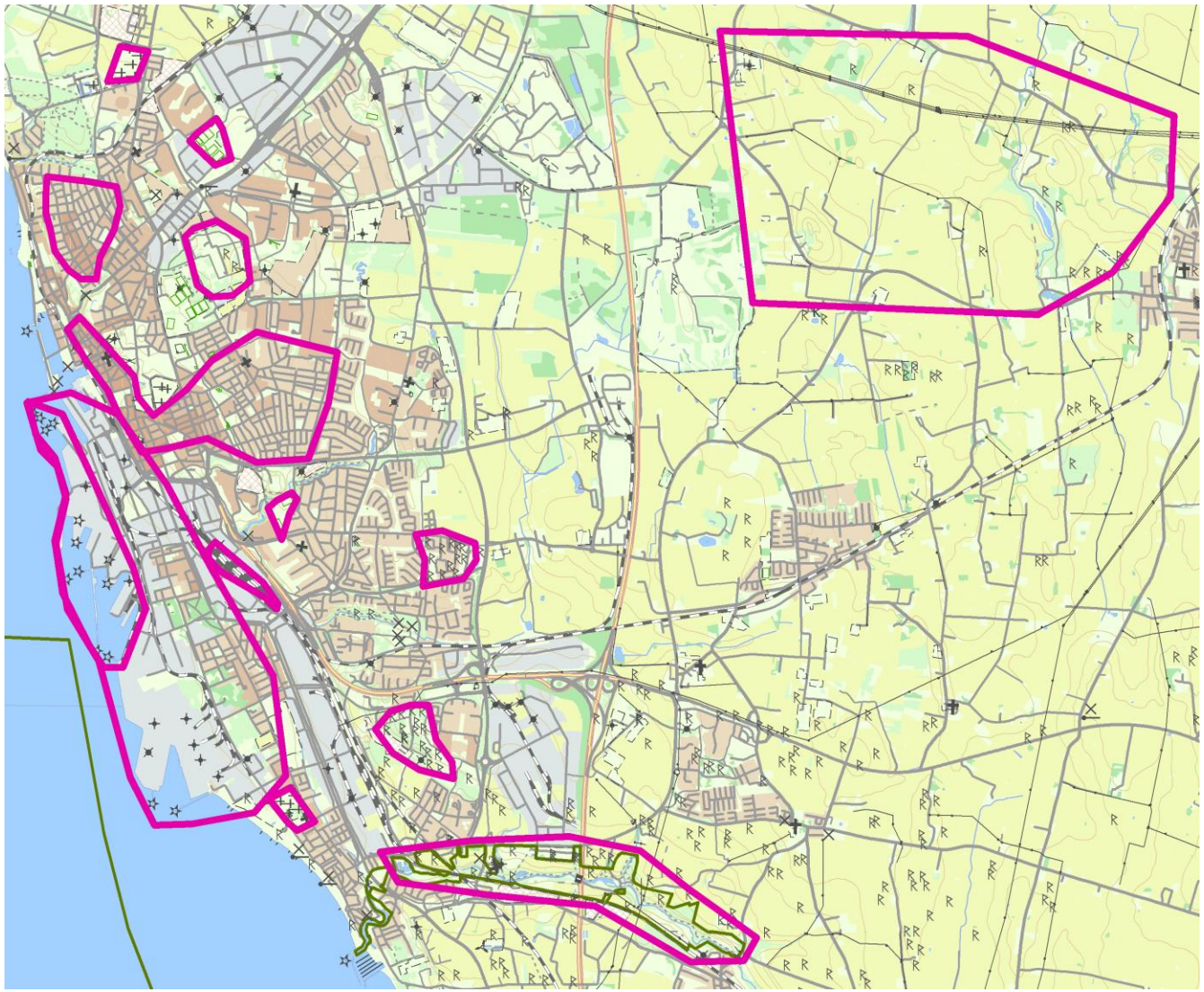
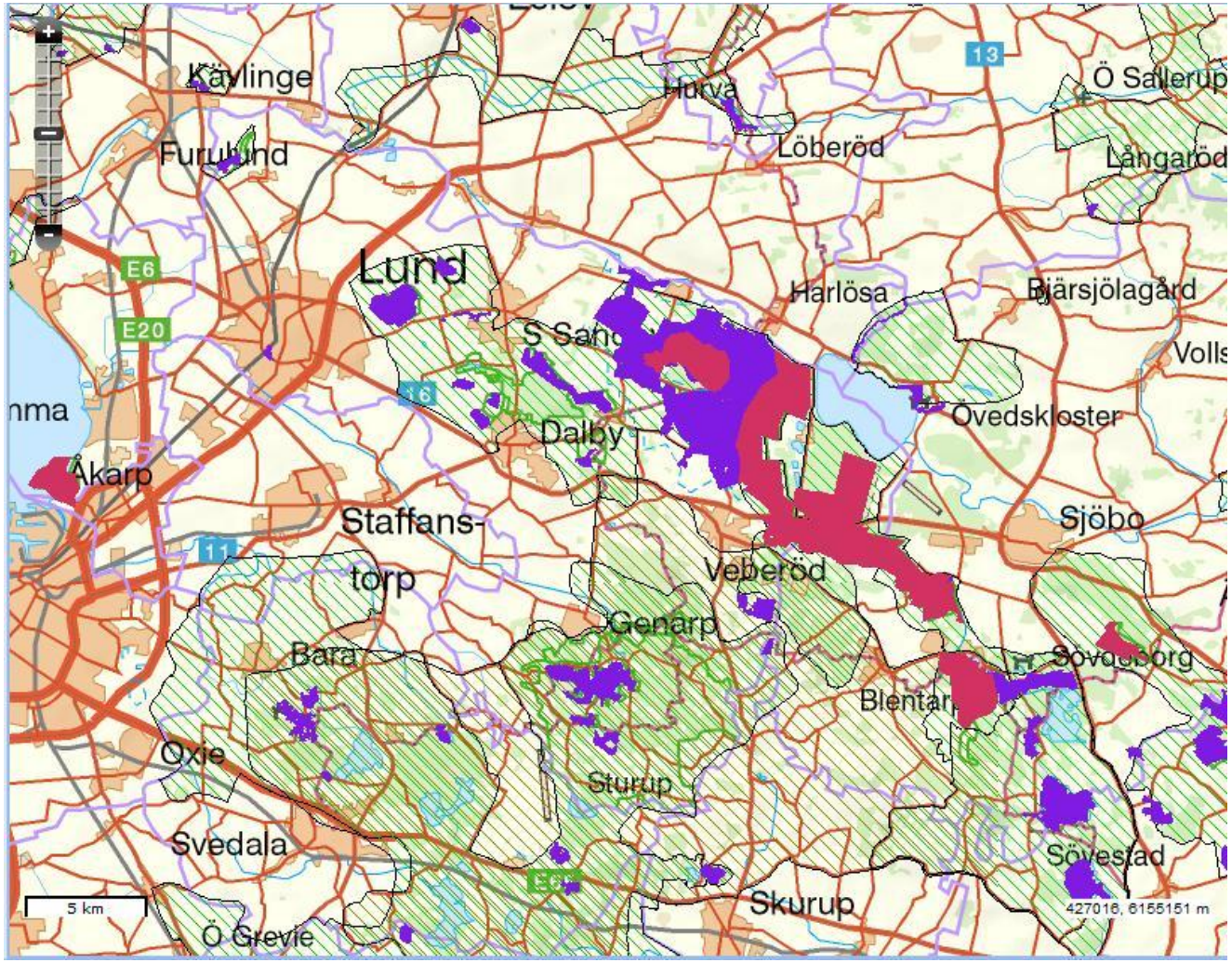
What regions in a map is difficult to read?
Can we identify those regions by analytical methods?



Geoportals

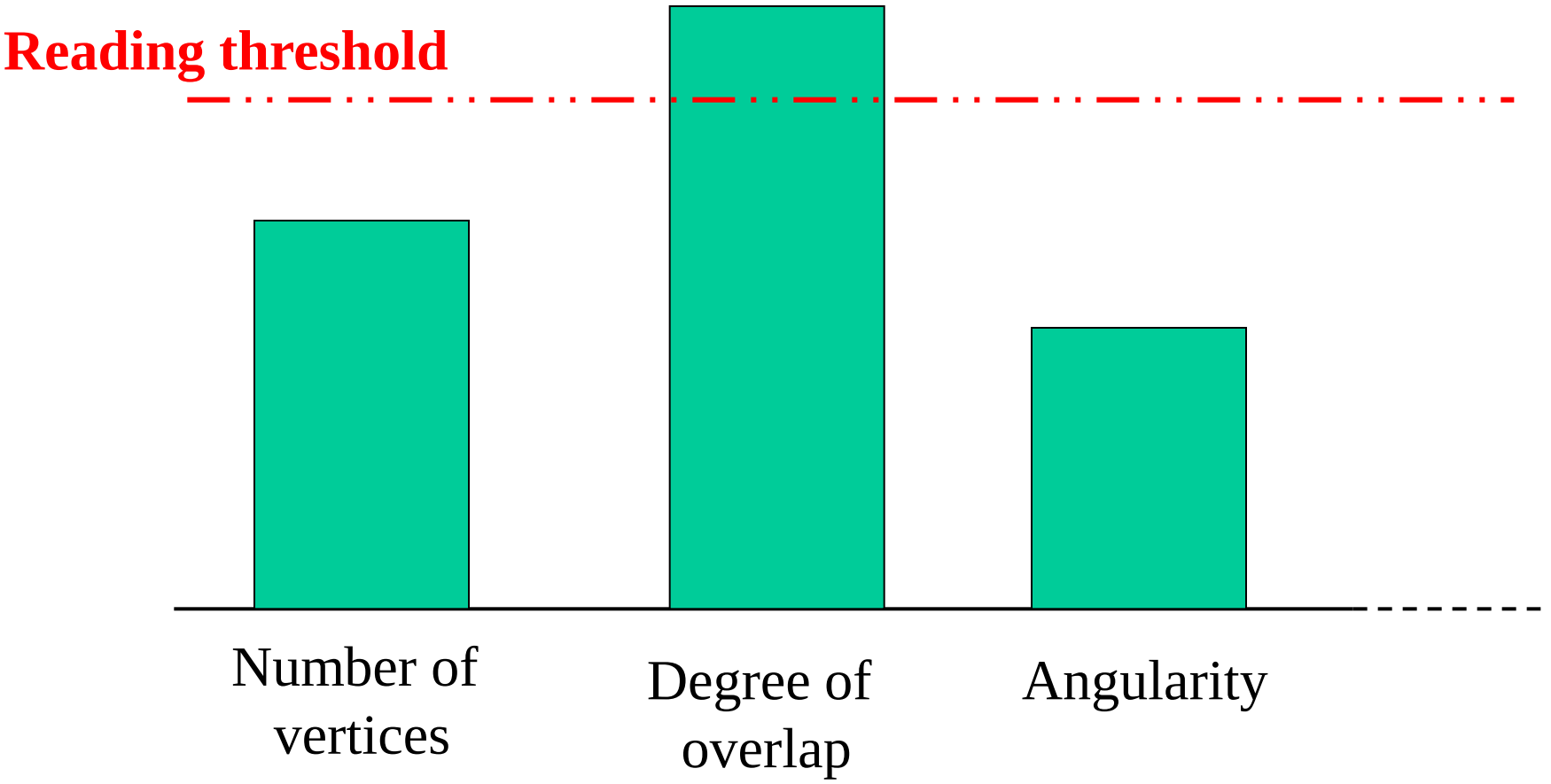
- data from several sources



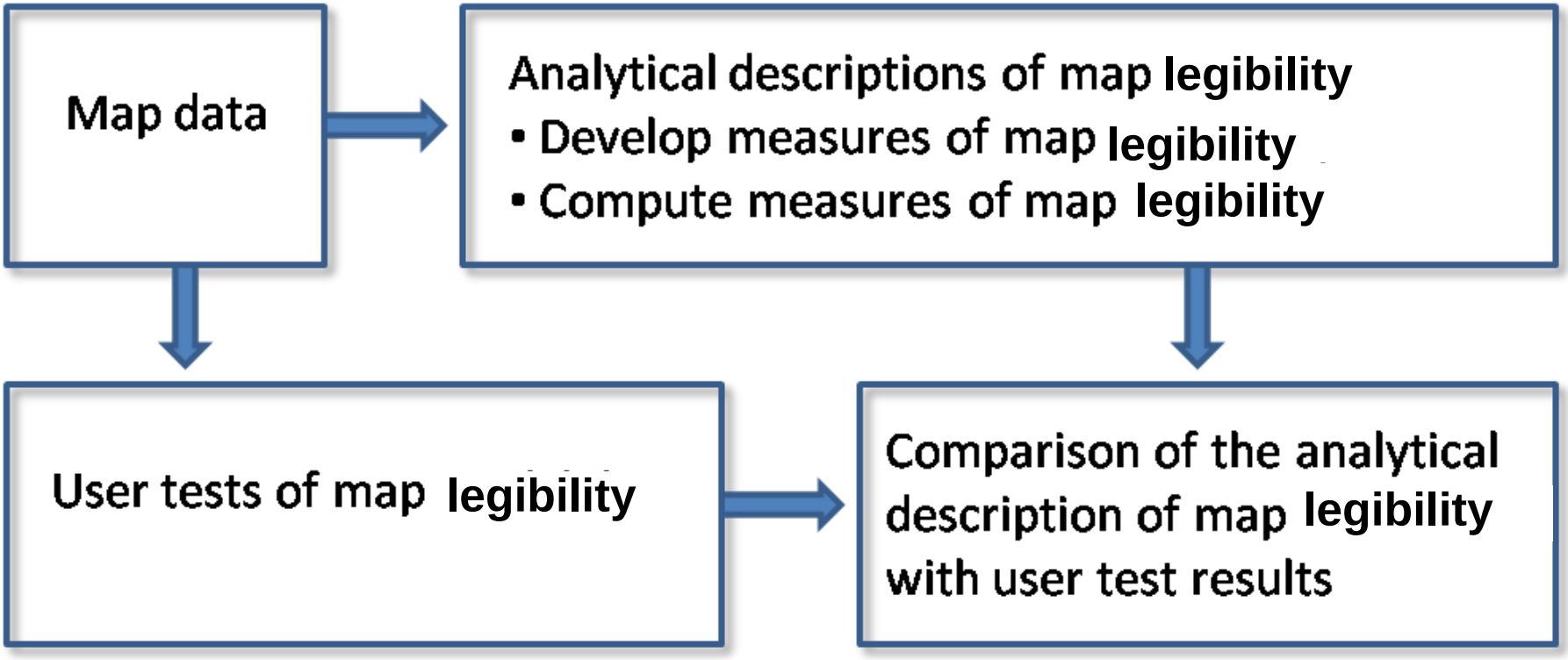
Disposition

* Method 1: Threshold method
* Method 2: Clustering method
* Evaluation of the methods
* Integration in a geoportal enviornment

Method 1: Threshold method

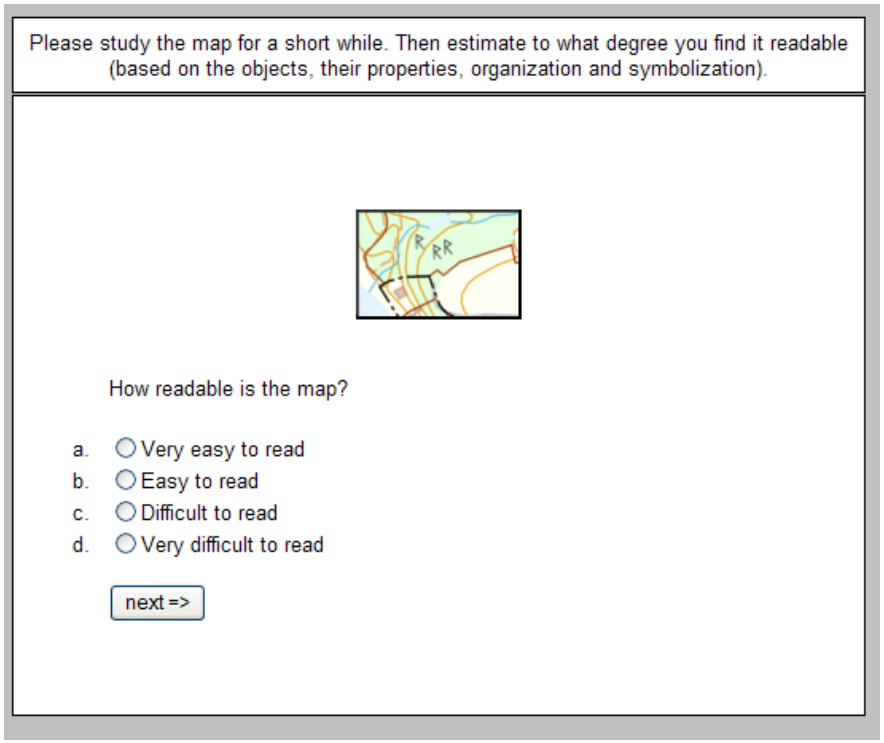


User studies of map legibility



Part of Hanna Stigmar's doctoral thesis

Web based user tests
- a couple of hundred participants



Analytical descriptions of map legibility

Four measure types:

- Amount of information
- Spatial distribution
- Object complexity
- Graphical resolution

	Amount of information	Spatial distribution	Object complexity	Graphical resolution
Minor objects	•Number of objects •Number of vertices •Object line length •Object area	•Spatial distribution of objects •Spatial distribution of vertices •Number of neighbours •Local density •Semantic homogeneity	•Object size •Line segment length •Angularity •Polygon shape	•Brightness difference •Hue difference
Line networks	•Number of objects •Number of vertices •Object line length •Object area		•Line segment length •Line connectivity •Angularity	•Brightness difference •Hue difference
Tessellation objects	•Number of objects •Number of vertices •Object line length	•Number of neighbours	•Object size •Line segment length •Angularity •Polygon shape	•Brightness difference •Hue difference
Field-based data	•Number of objects •Number of points in the objects •Object line length		•Line segment length •Angularity	
All objects	•Number of object types •Number of objects •Number of vertices •Object line length •Object area	•Proximity indicator •Degree of overlap		

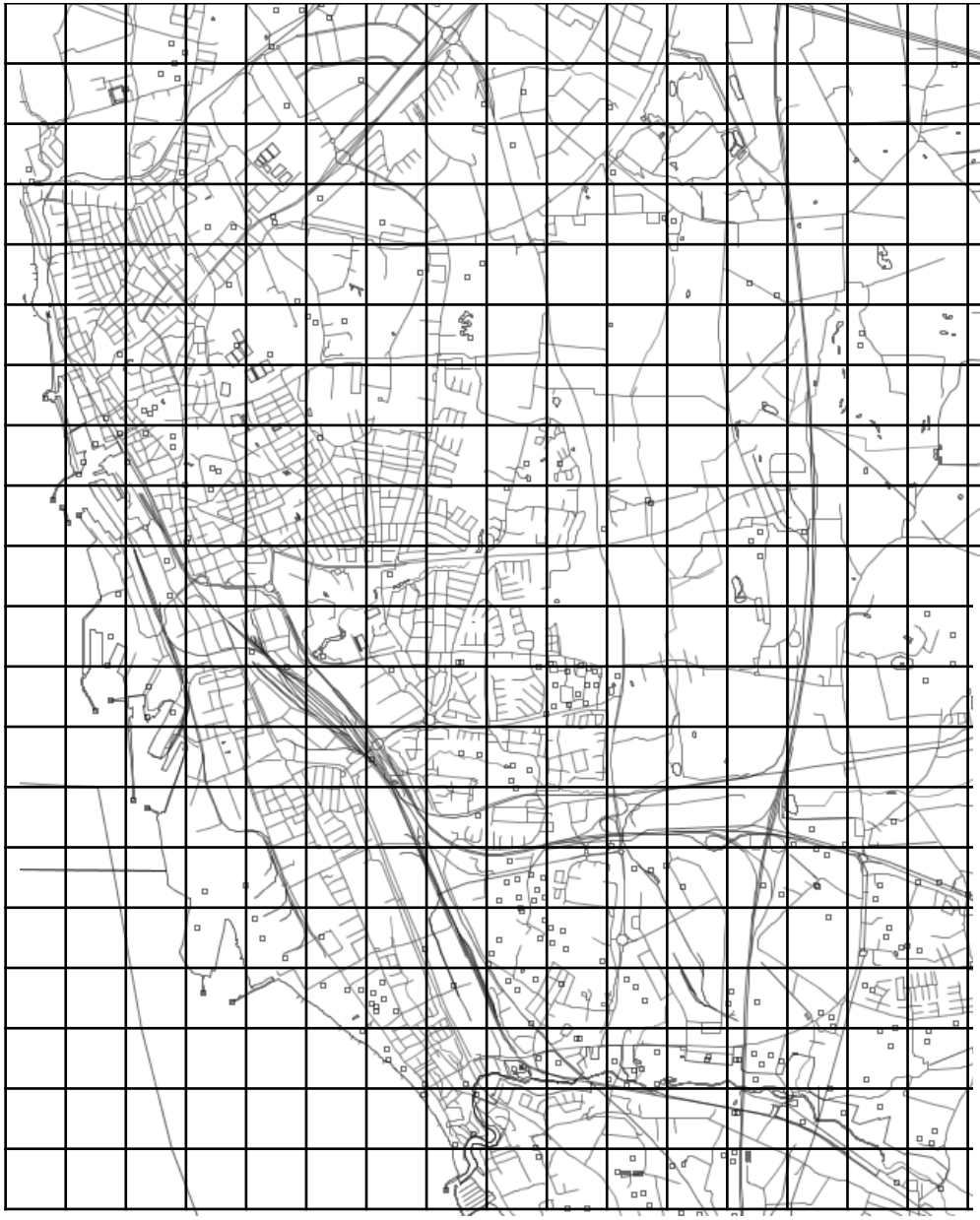
Correlation between analytical description and user tests

	Two legibility classes
Manual interpretation of threshold values	85%
Multiple linear regression	81%
Support vector machine	83%
Artificial neural network	71%

Methodology of the threshold method

Raster based method. Each cell that do not obey one of the limits below is regarded as difficult to read:

Number of objects (<11/cm²)
Object line length (<17cm)
Number of vertices (<450/cm²)
Number of object types (<17)
Degree of overlap for disjoint objects (<3)
Angularity (<40/cm)

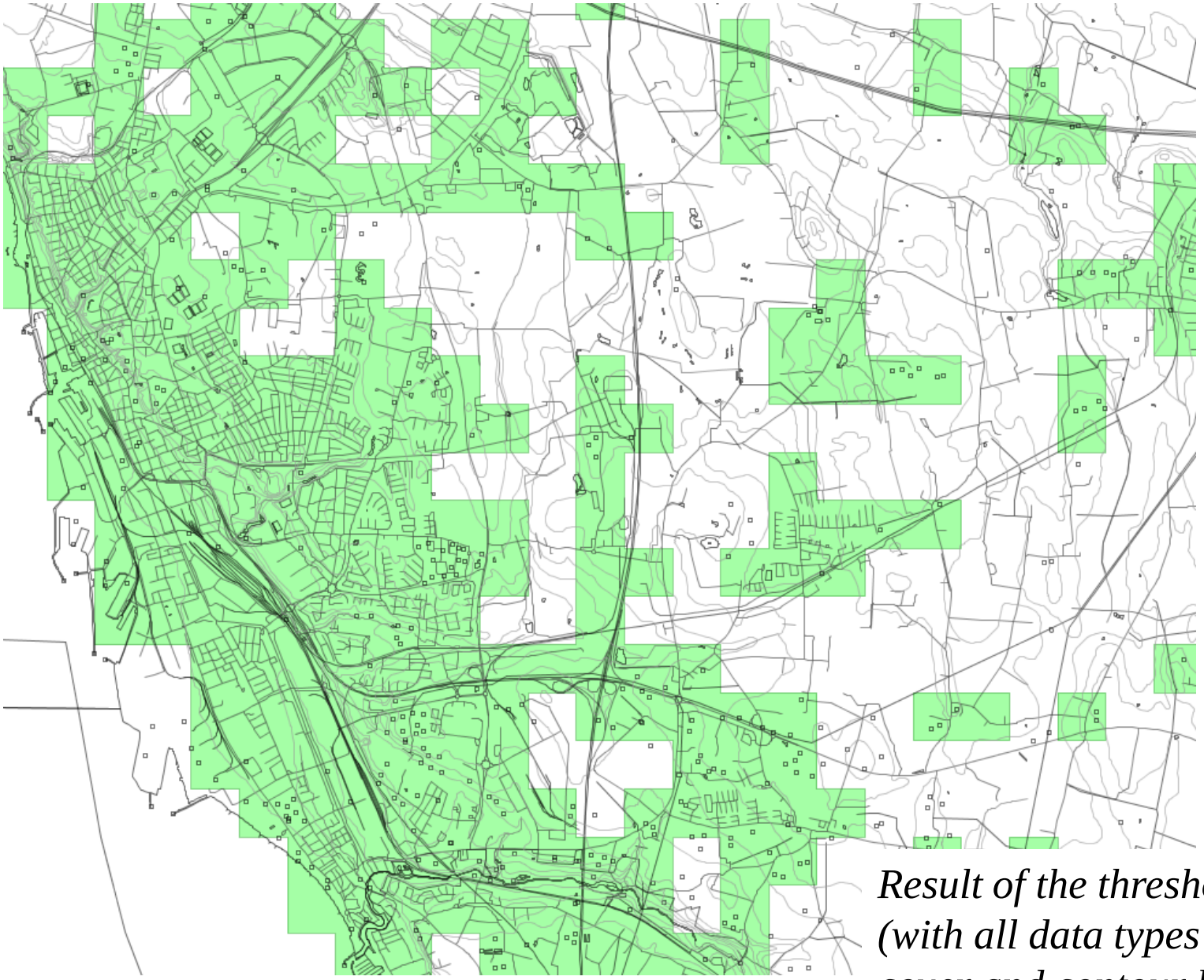


cell Size = 1cm²

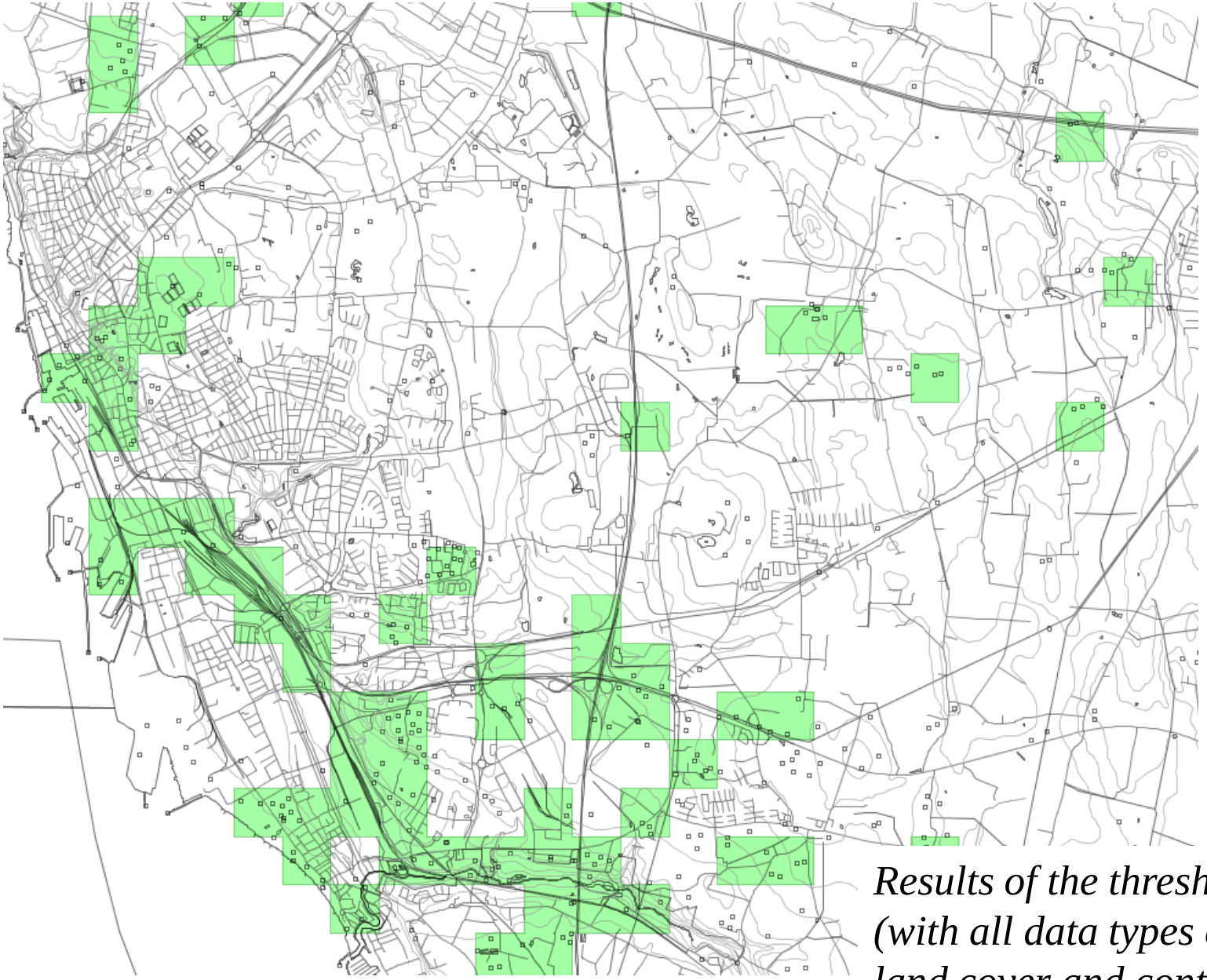
each grid cell represents a specific map region

one layer for each measured value

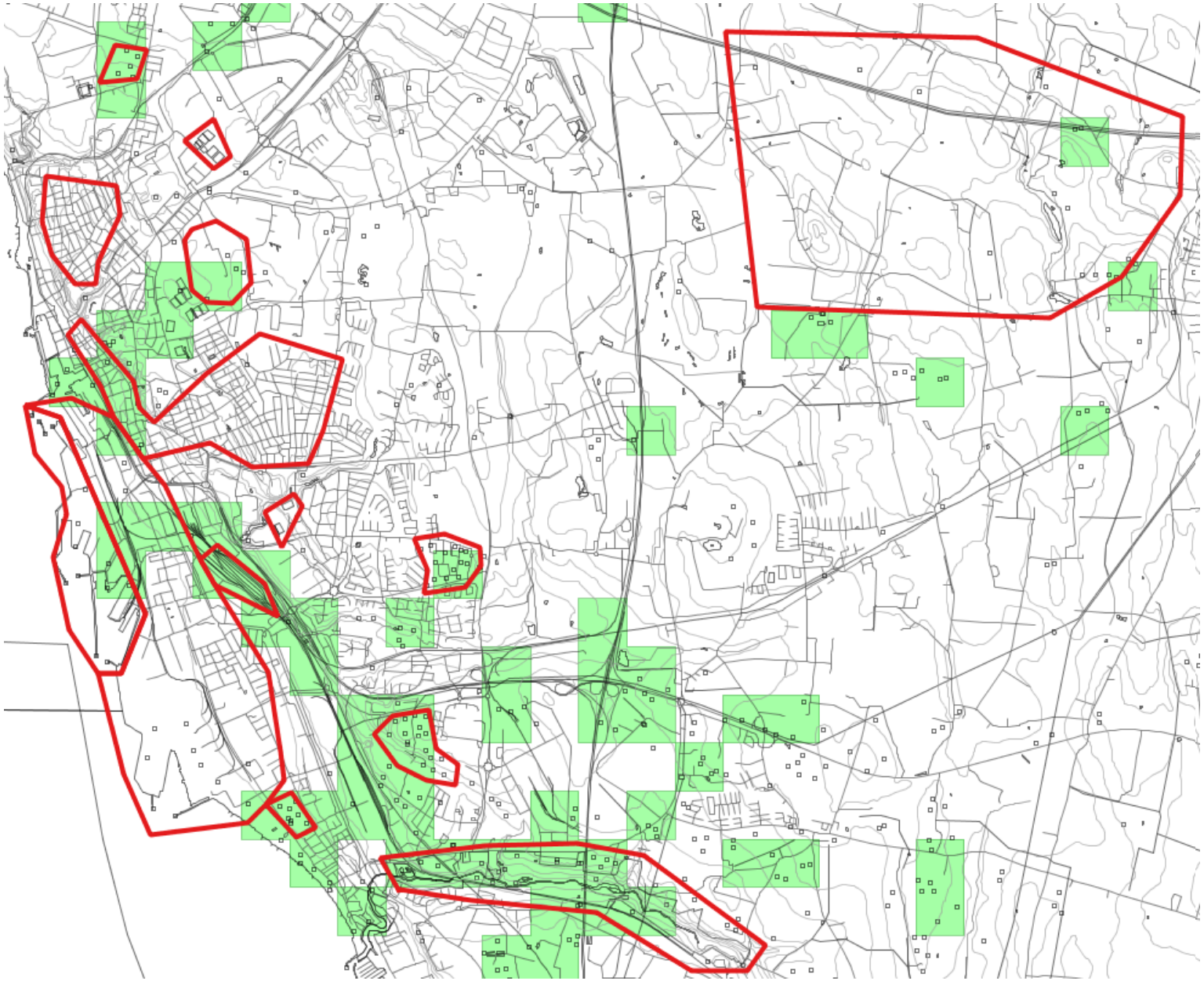
If one layer exceeds a threshold value, the entire grid cell is regarded as difficult to read.



Result of the threshold method (with all data types except land cover and contour lines)

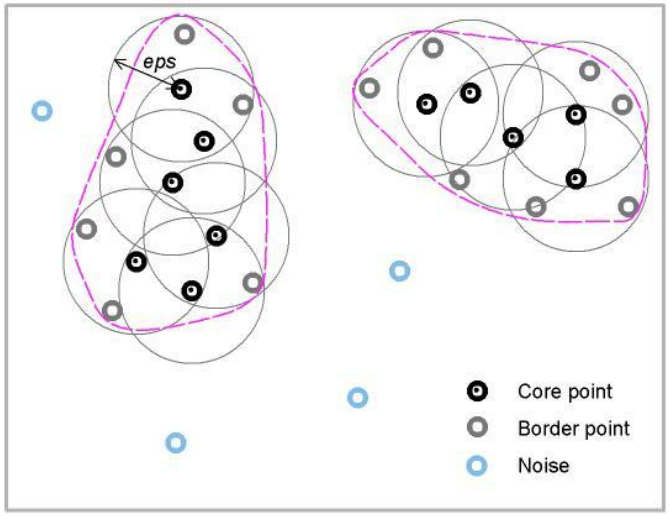


*Results of the threshold method (with all data types **except roads**, land cover and contour lines)*

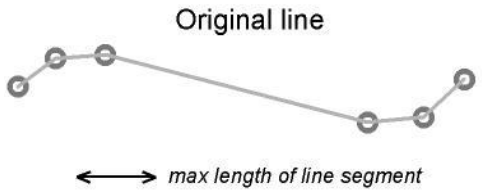


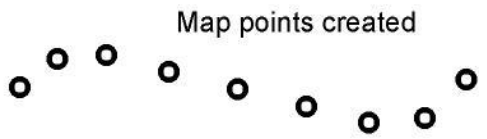
Method 2: Clustering method

DBSCAN

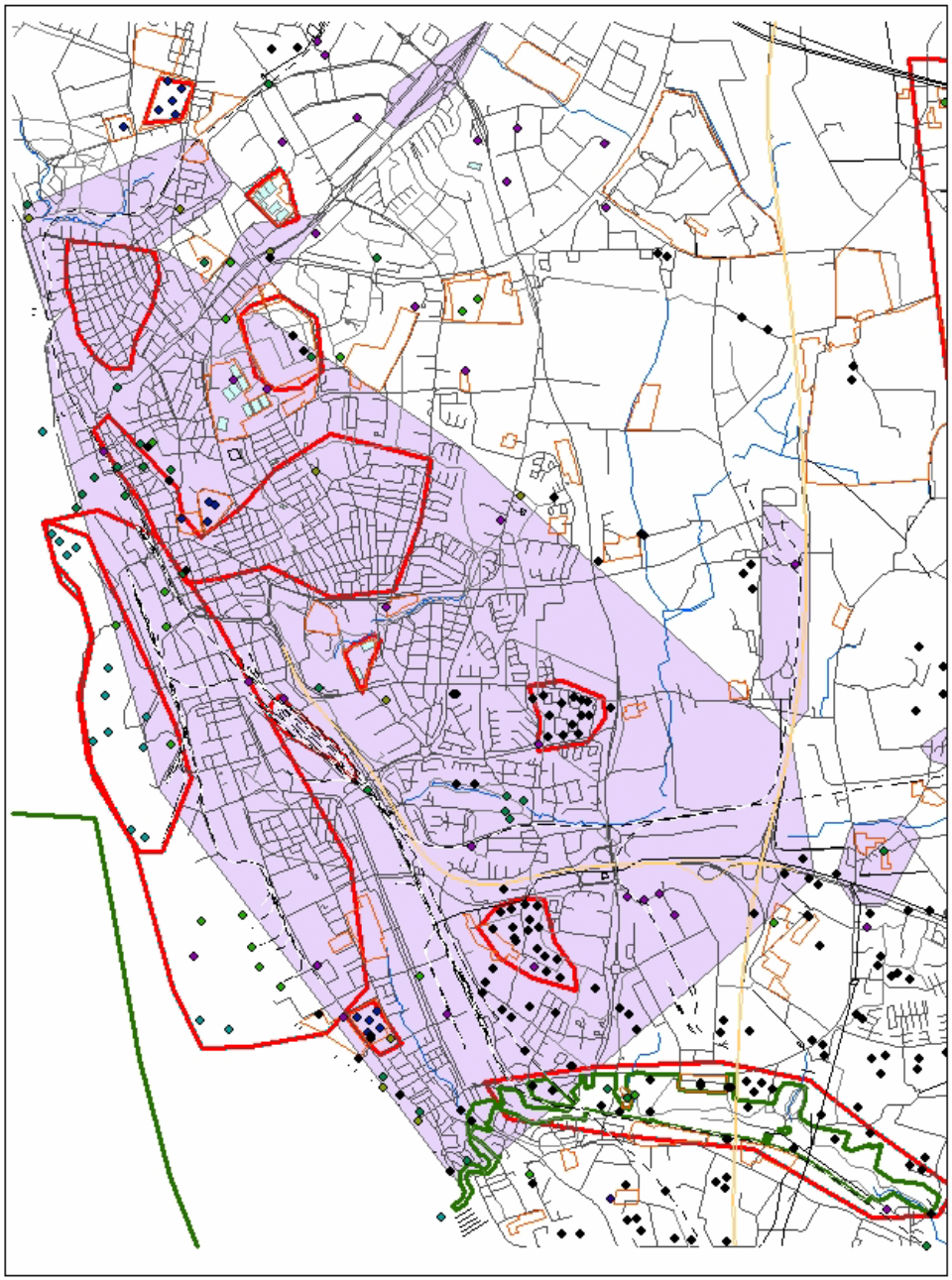


Balance point vs. line/polygon features





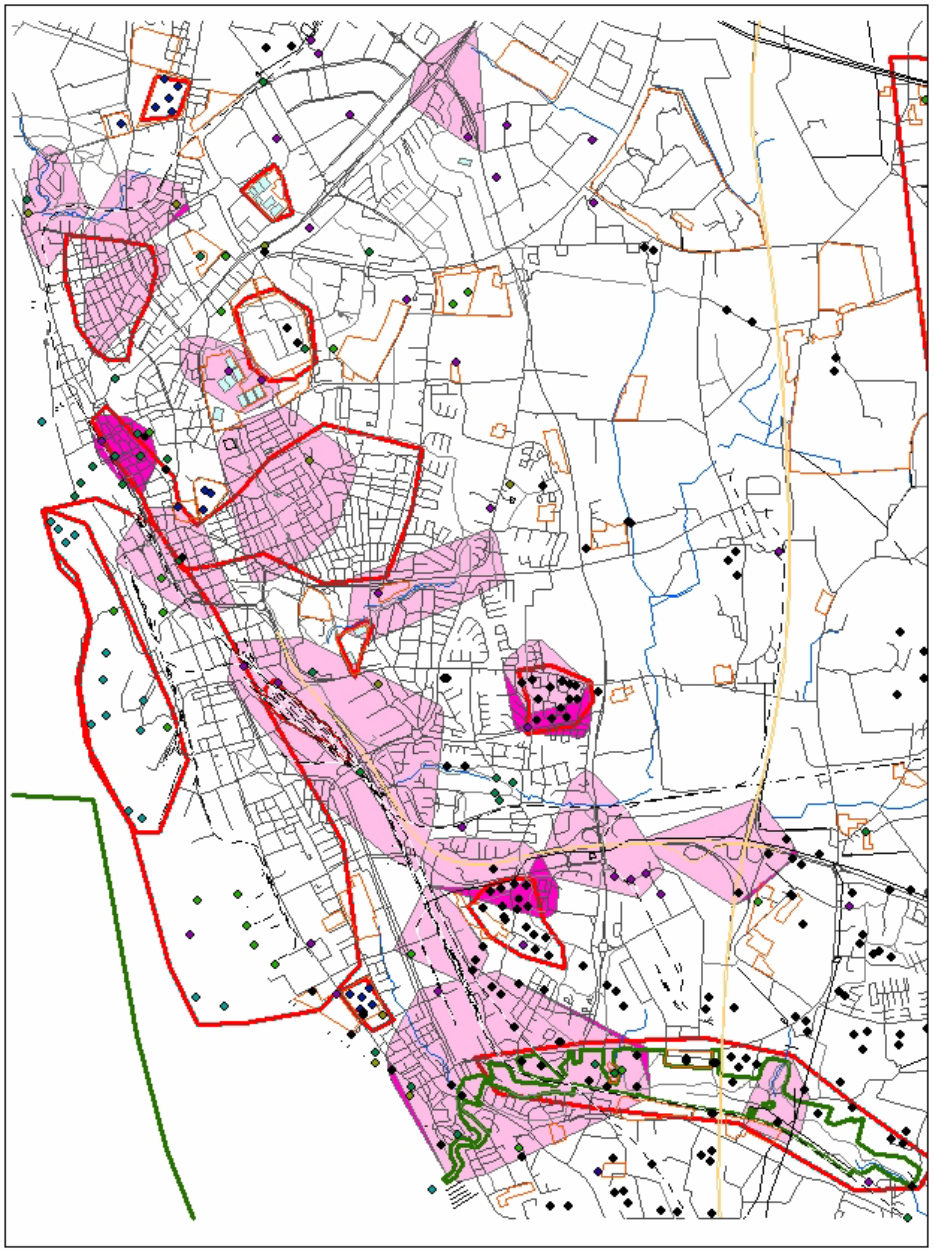
Point objects



Identifying areas with poor legibility - I

- no additional map points for point feaures

Max distance between map points	**50 m**
Ratio line length/no. of vertexes	**50 m**
Tolerance (Douglas Peucker)	**9 m**
eps (DBSCAN)	**75 m**
minPts (DBSCAN)	**10**
Min area (convex hull of cluster)	**250 000 m^2**



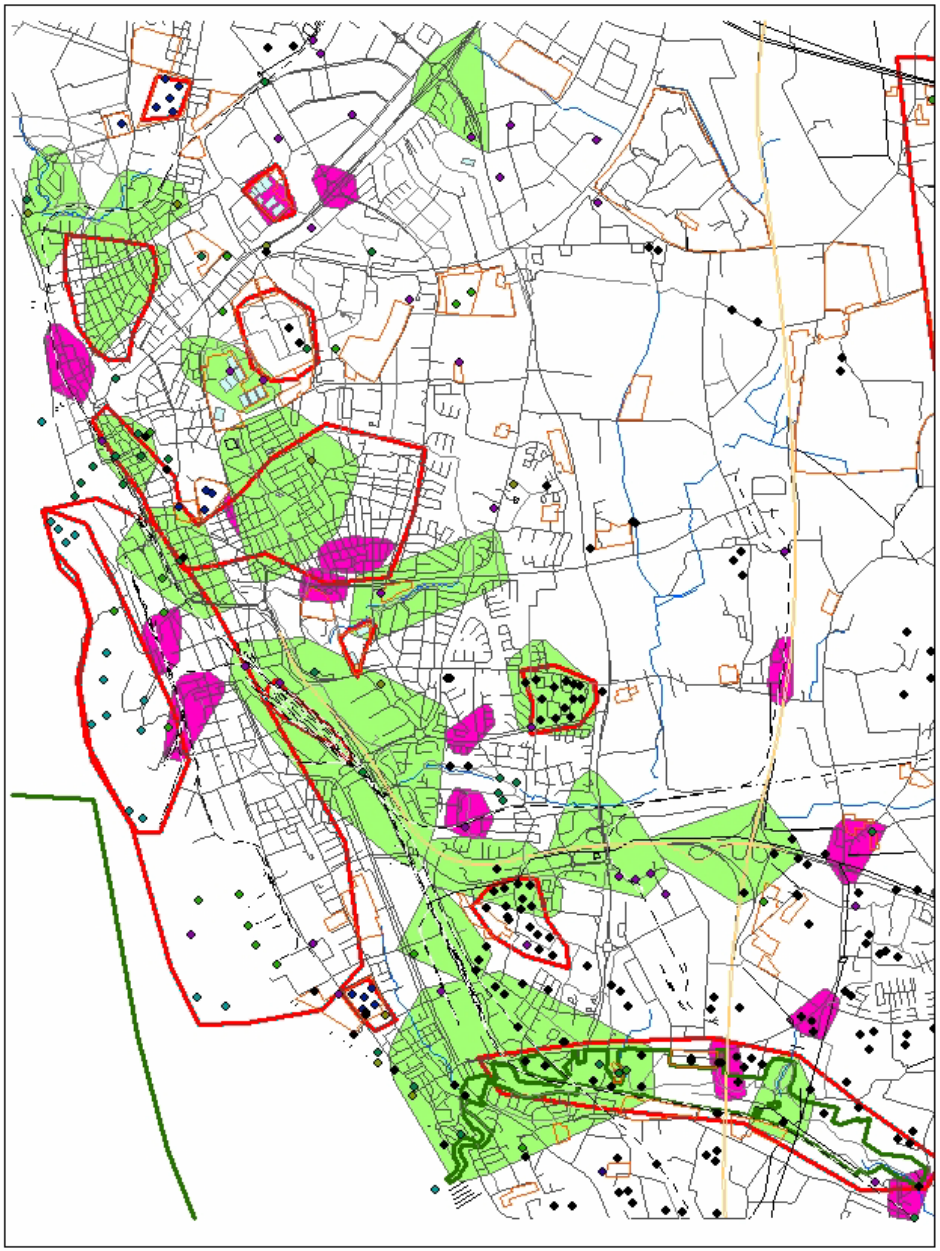
Areas of poor legibility:

- Identified by users (Stigmar & Harrie, 2011).
- Identified by DBSCAN - 4 additional point per point
- Identified by DBSCAN - 8 additional point per point

Identifying areas with poor legibility - II

- additional map points for point features (4 and 8)

Max distance between map points	**50 m**
Ratio line length/no. of vertexes	**50 m**
Tolerance (Douglas Peucker)	**10 m**
eps (DBSCAN)	**75 m**
minPts (DBSCAN)	**15**
Min area (convex hull of cluster)	**250 000 m^2**



Areas of poor legibility:

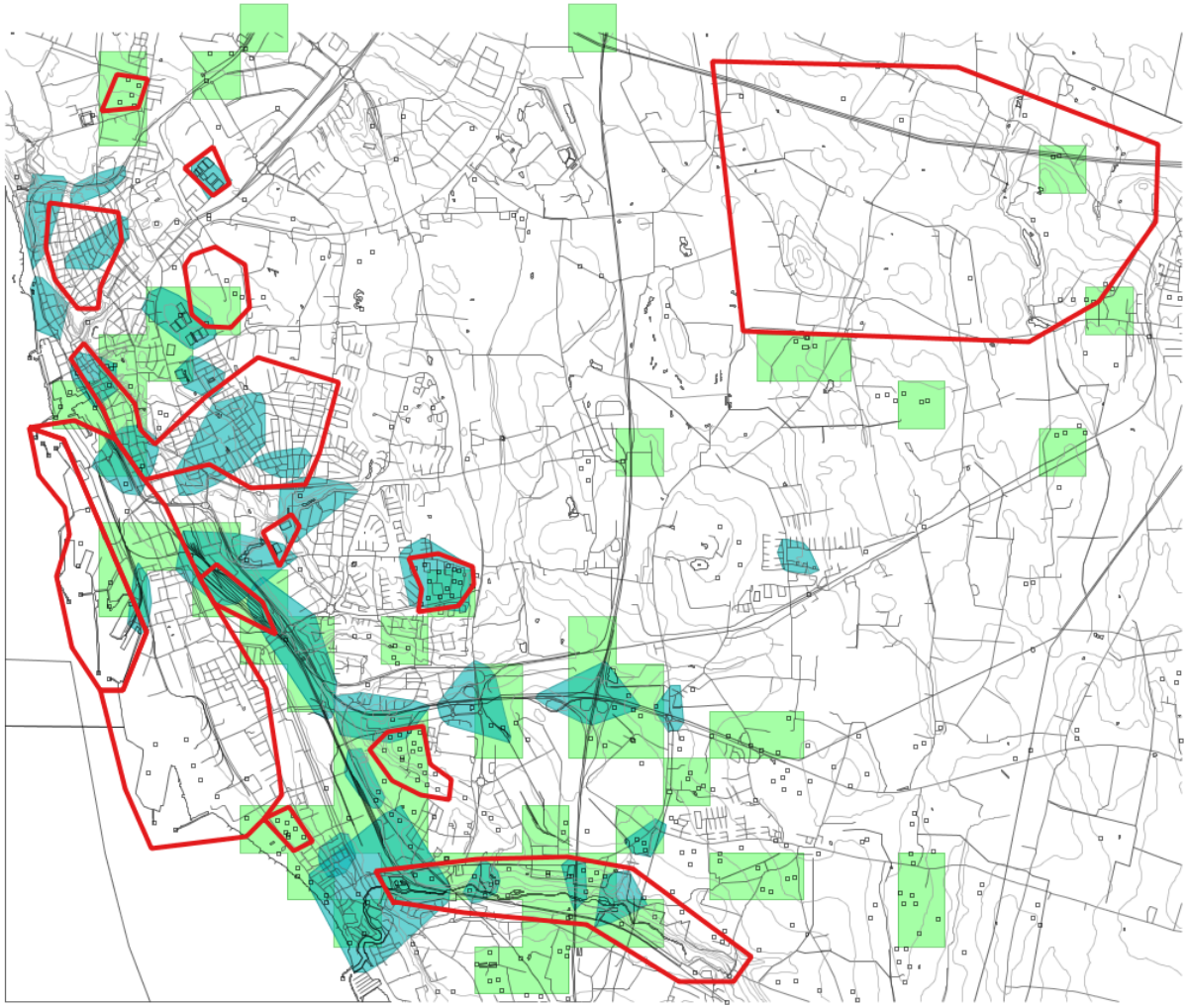
- Identified by users (Stigmar & Harrie, 2011).
- Identified by DBSCAN - Area > 250 000 km2
- Identified by DBSCAN - Area > 100 000 km2

Identifying areas with poor legibility - III

- 8 additional map points for point features and reduced min area

Max distance between map points	**50 m**
Ratio line length/no. of vertexes	**50 m**
Tolerance (Douglas Peucker)	**10 m**
eps (DBSCAN)	**75 m**
minPts (DBSCAN)	**15**
Min area (convex hull of cluster)	**100 000 m^2**

Evaluation



Red:
User study

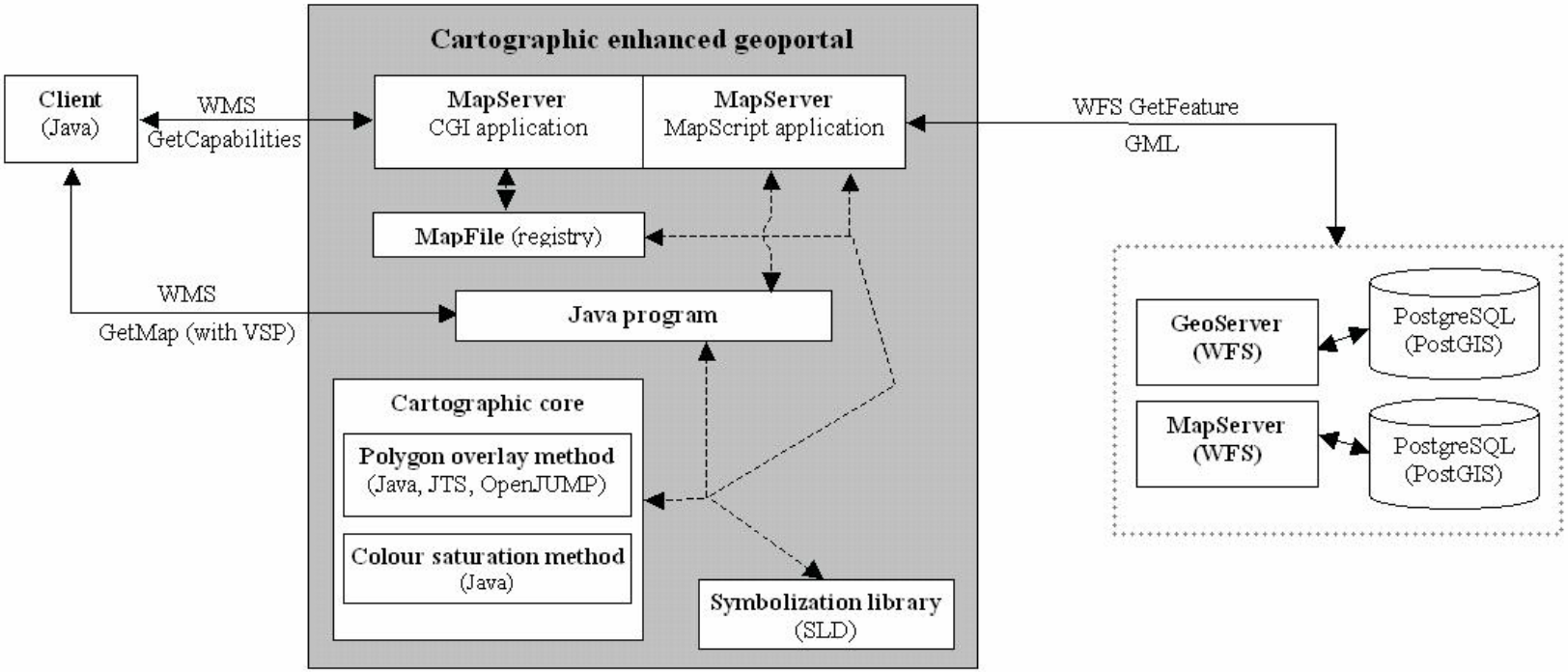
Light green:
Threshold
method

Blue:
Clustering
Method
(DBSCAN)

Geoportals - view services
– traditionally a cartographer designs a map

Cartographic enhanced geoportal

- a test bed for methods to improve cartography



Thanks for your attention!

Questions?