Cartographically Plausible Label Placement

A Multi-criteria Model for Good Point-label Placement on OSM Maps

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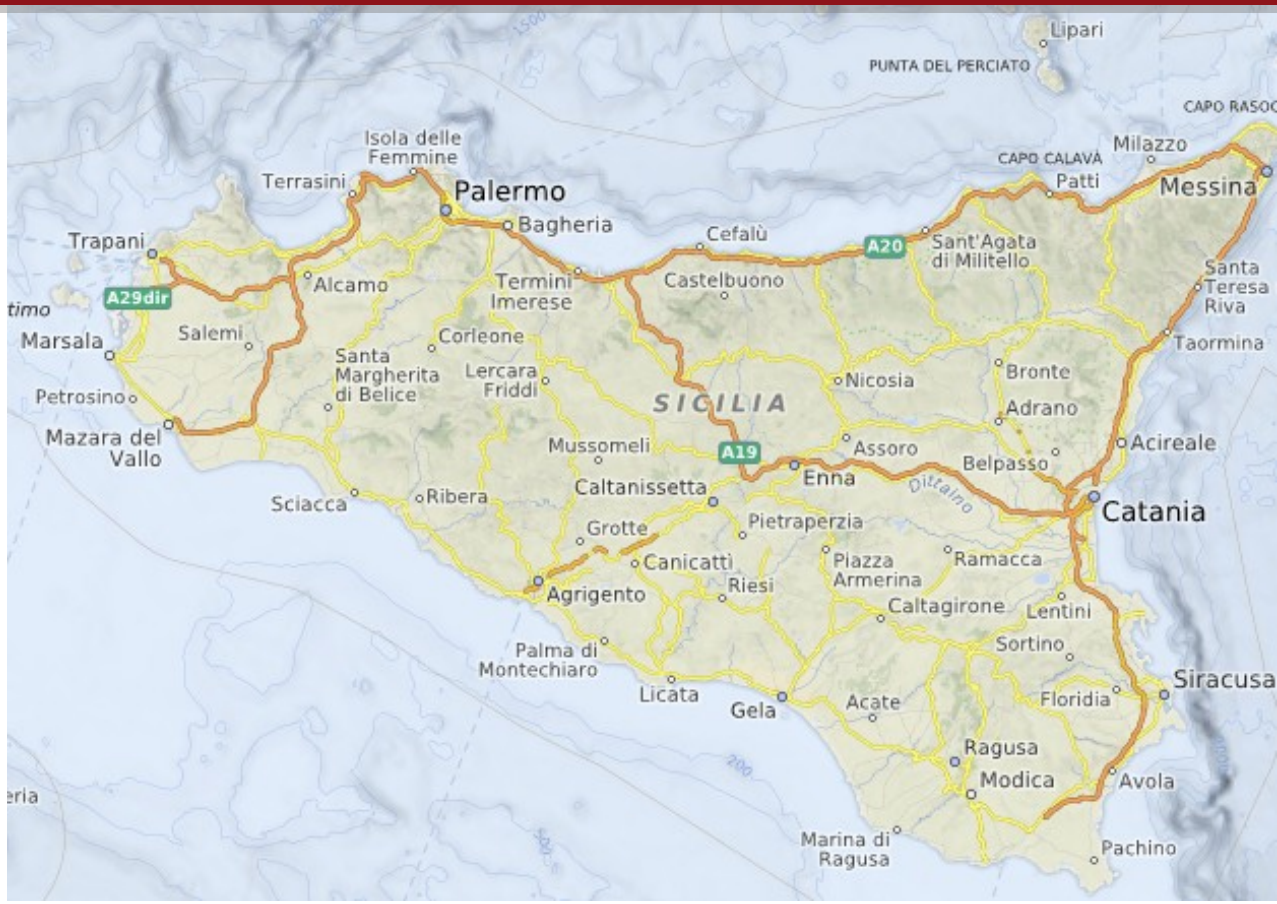

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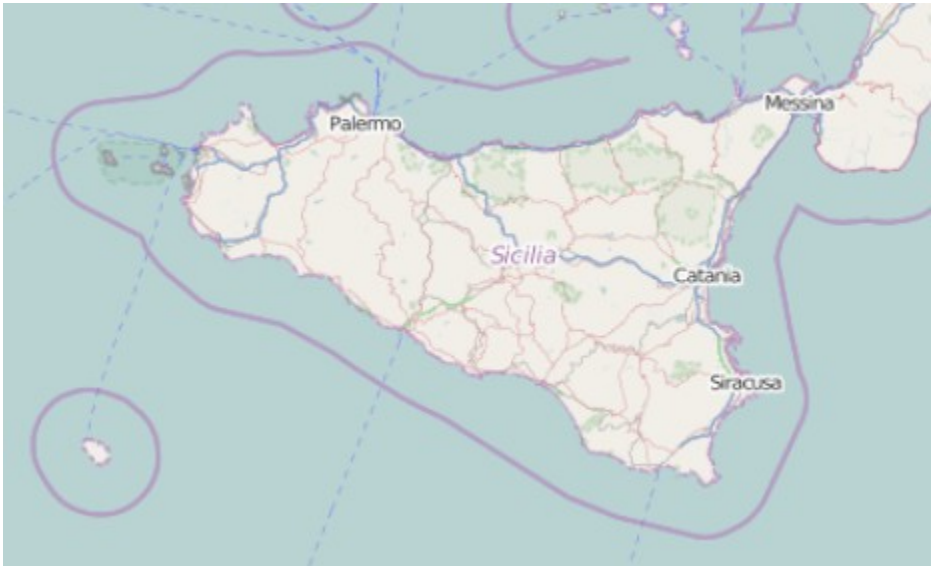
Motivation and goals

- Labeling on automatically generated maps is poor and untidy.
- Develop a model that considers all cartographic guidelines.
- Apply the proposed model to label a world map using OSM data.
- Present much more data on OSM maps

Automated lettering [5 pts only]



SOURCE: OpenStreetMap.org

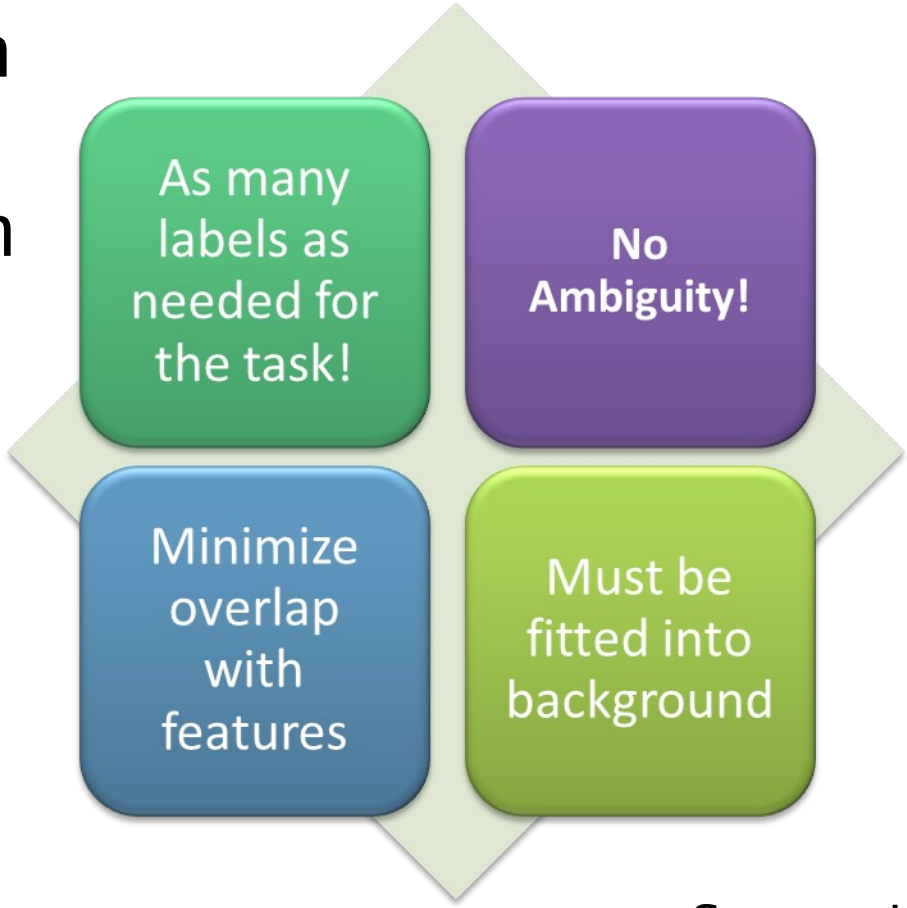
Manual lettering [54 + polygons]

SOURCE: Encyclopædia Britannica World Atlas

Purpose:

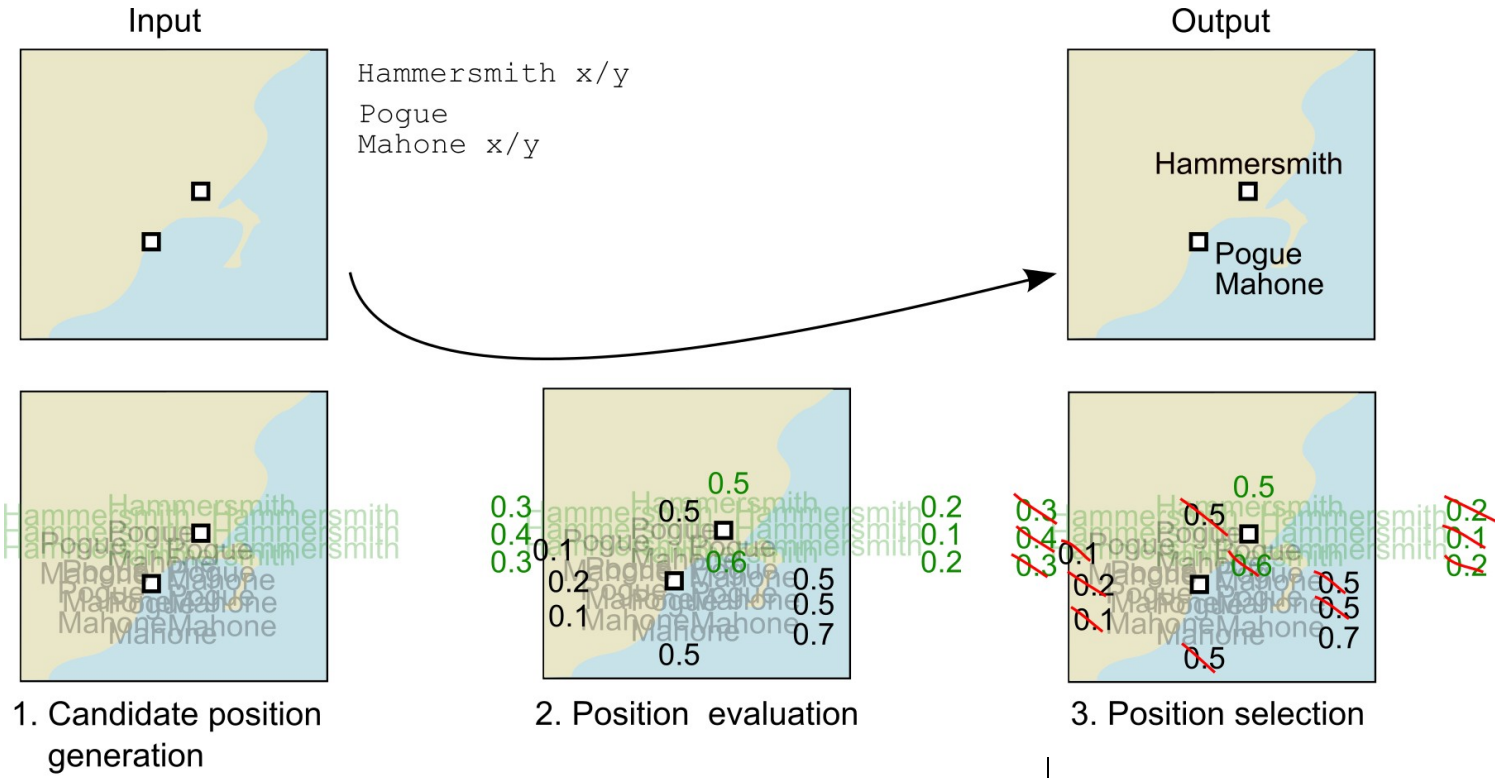
Quantification
Orientation
Differentiation

Constraints



Source: Imhof, E 19

Label placement subtasks



Positioning around symbol
Feature priority

Background feature overlap
Cluttering
Disambiguation
Coastal places

Greedy algorithm

Simulated Annealing
Genetic algorithm
Tabu Search algorithm
Artificial intelligence proced.

Multi-criteria model

$$\text{Maximize} \quad Q(x) = \sum_{i=1}^{P_n} \sum_{j=1}^{N} \left(\beta_1 F_{i,j}^{prior} + \beta_2 F_{i,j}^{pos} + \beta_3 F_{i,j}^{over} + \beta_4 F_{i,j}^{disamb} + \beta_5 F_{i,j}^{clut} + \beta_6 F_{i,j}^{coast} \right) x_{i,j}$$

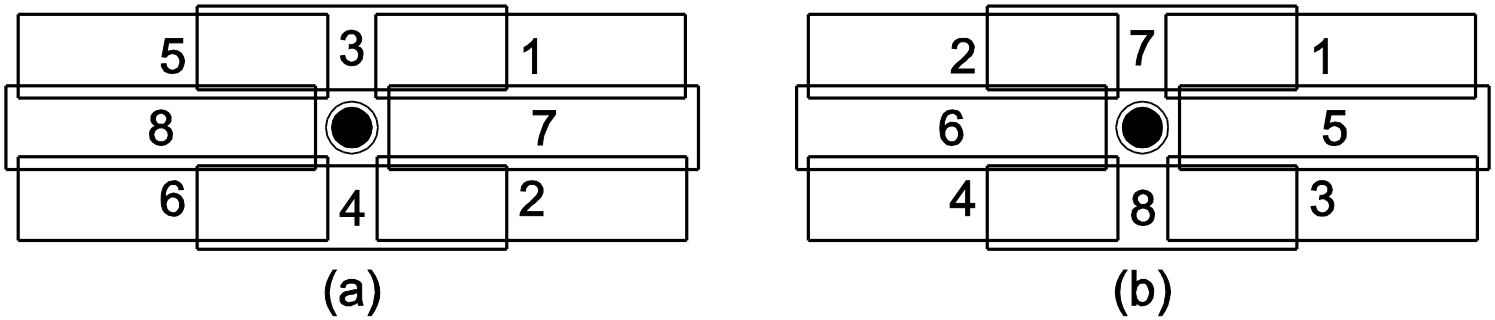
$$\text{Subject to} \quad \sum_{i=1}^{P_n} x_{i,j} \leq 1, \forall\, j = 1.$$

$$\text{and} \quad x_{i,j} + x_{k,m} \leq 1$$

where $x_{i,j} \in \{0,1\}, \forall\, i = 1..P_n, \forall\, j = 1..N$, N– the number point features, P_n – number of positions, $F_{i,j}$ are metrics that represent cartographic preferences of label placement.

Positioning metric

- Optical coincidence
- Legibility
- Ascending and descending letters



Commonly used models for positional prioritization

Priority metric

- Population
- Importance
- Administrative status

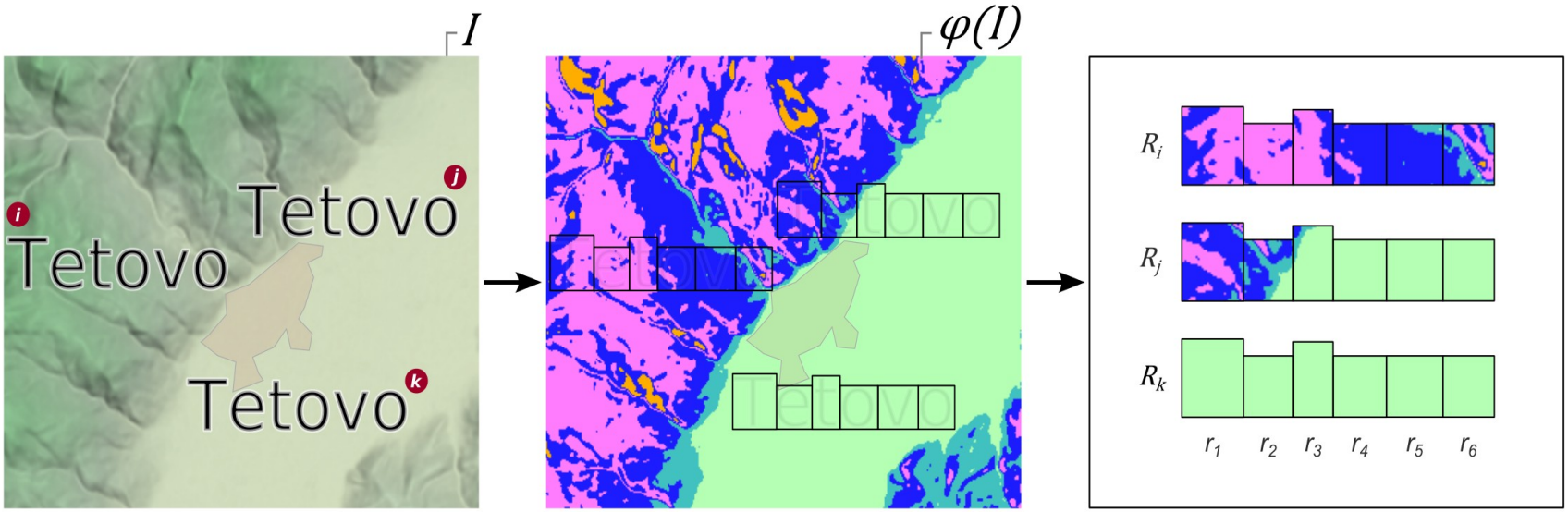
Frankfurt am Main (~690,000)

Worms (~80,000).

OSM tags:
place=*
population=*

Feature overlap metric

- Create a raster image with background information (e.g., road network, water bodies, shaded relief).
- Apply image segmentation algorithm (reduce number of colours).
- Perform analysis to detect homogeneous regions.



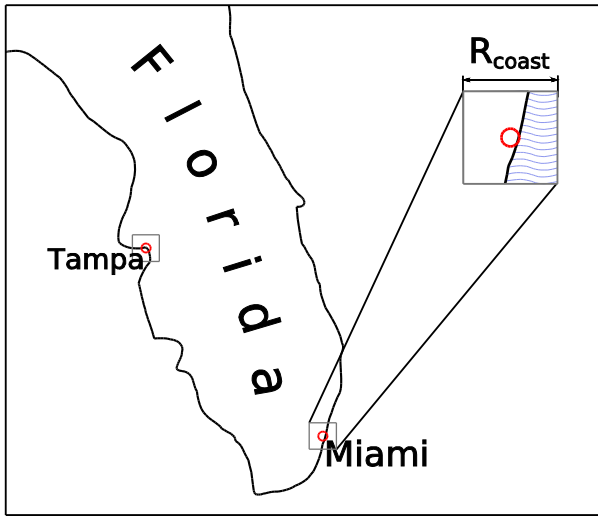
Coastal place metric

Requirements:

- Datasets usually lack coastal place attribute.
- The point-shore relationship is scale-dependent.

Approach methodology:

- Coastline dataset
- Define the neighborhood of a place.
- Compute area of water.
- Decide whether it is a coastal place or not.



Comparison of label placement

Number of labels: 5

Source: OpenStreetMap.org

Number of labels: 12

Source: Mapbox Streets

Number of labels: 54

Source: Google Maps

Number of labels: 55

Source: Proposed model using OSM data

Experimental results

Tested region: northern part of Denmark

Metrics	Solver	Labels	Quality	Time [s]
Priority + Positioning (2/6)	Greedy	59 (71.95 %)	0.617	0.019
All (6/6)	Simulated Annealing	74 (90.24 %)	0.834	3.569

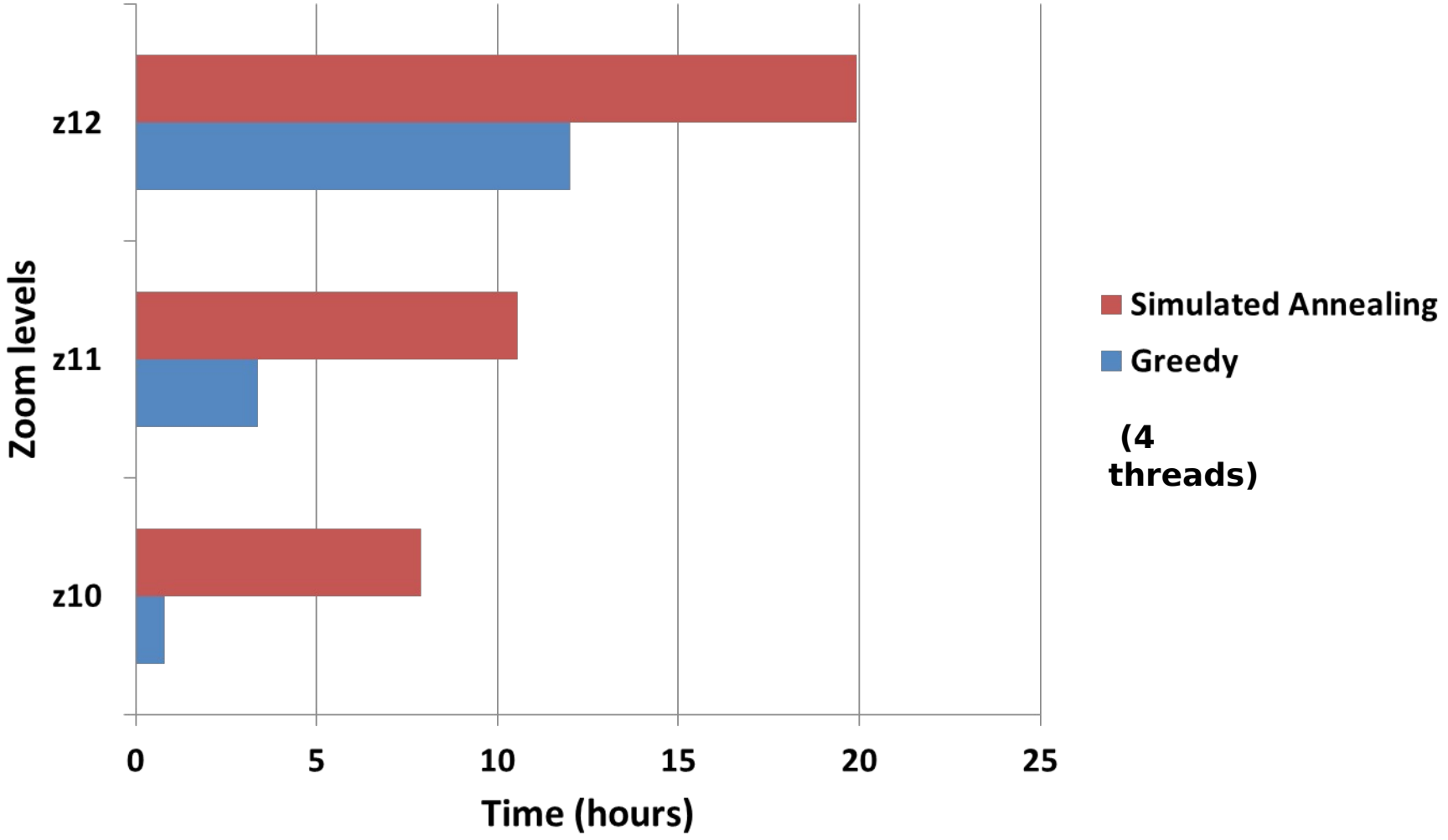
Performance and quality depends on:

- Number of input labels
- Number of quality metrics
- Solving algorithm

Pros and cons:

- High cartographic quality
- SA gives 7% more labels
- Time-consuming and resource-intensive task

Experimental results



Summary

- Detailed description of the model

  Rylov, M. and Reimer, A. 2014 "**A Comprehensive Multi-criteria Model for High Cartographic Quality Point-Feature Label Placement**", *Cartographica*, 49(1): 52-68.

- The model can be reproduced in your own solution or in Mapnik, GeoServer, Mapserver, etc.

- A map with a sophisticated label placement for the whole globe

  http://openmapsurfer.uni-hd.de (OSM Roads layer)

- The proposed model is implemented within the **MapSurfer.NET** framework

  http://openmapsurfer.uni-hd.de/Framework/info.html

Thanks for your attention!

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