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A Displacement Method for Maps Showing Dense Sets of Points of Interest

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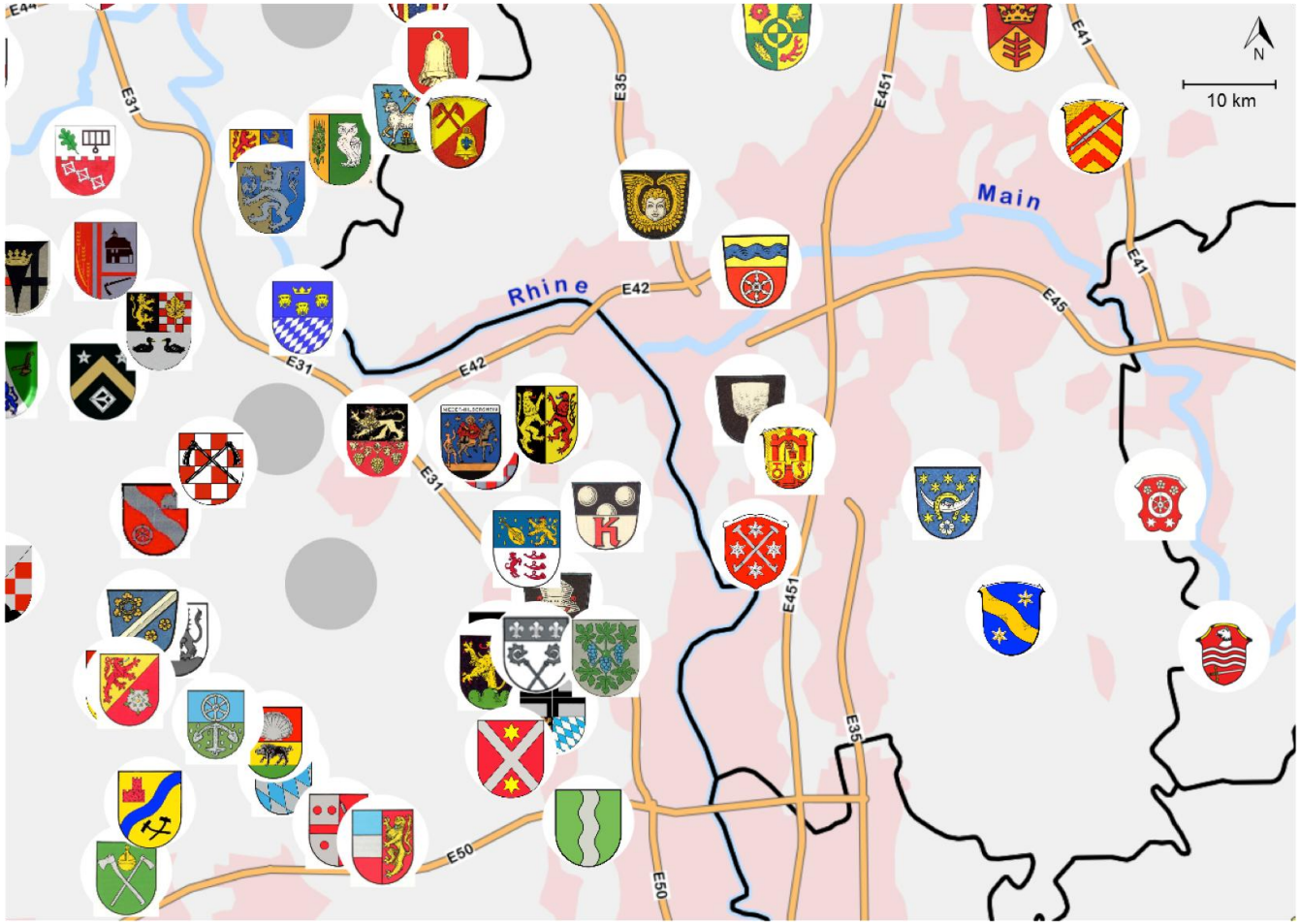
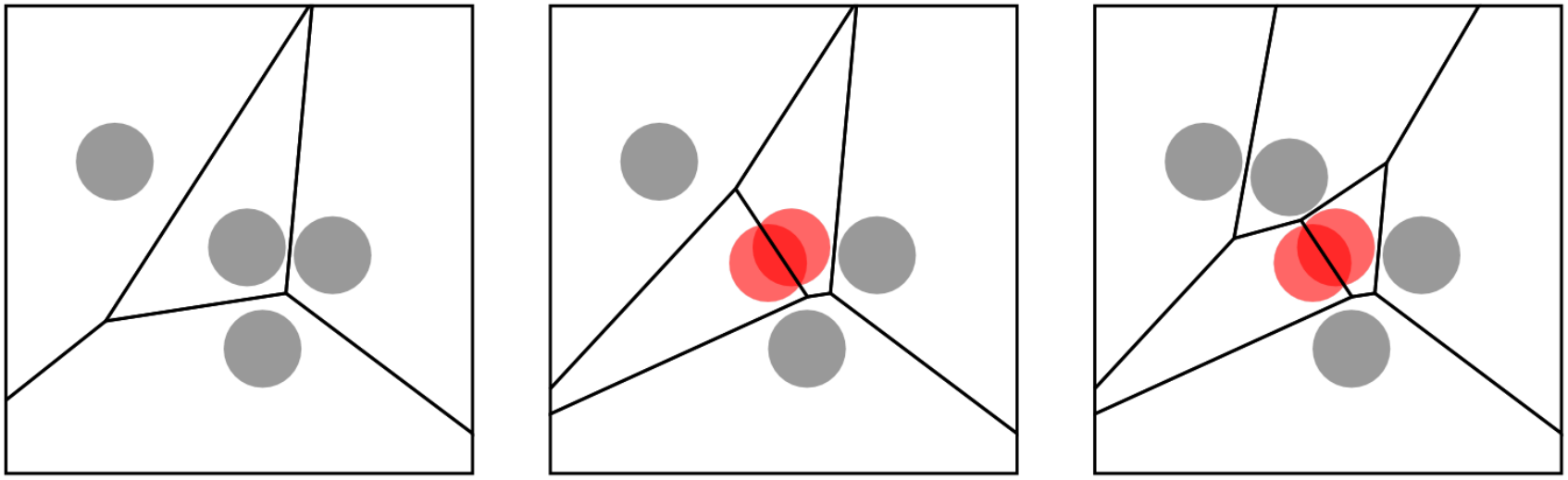
Motivation

- Problem: cluttered symbols on user generated maps



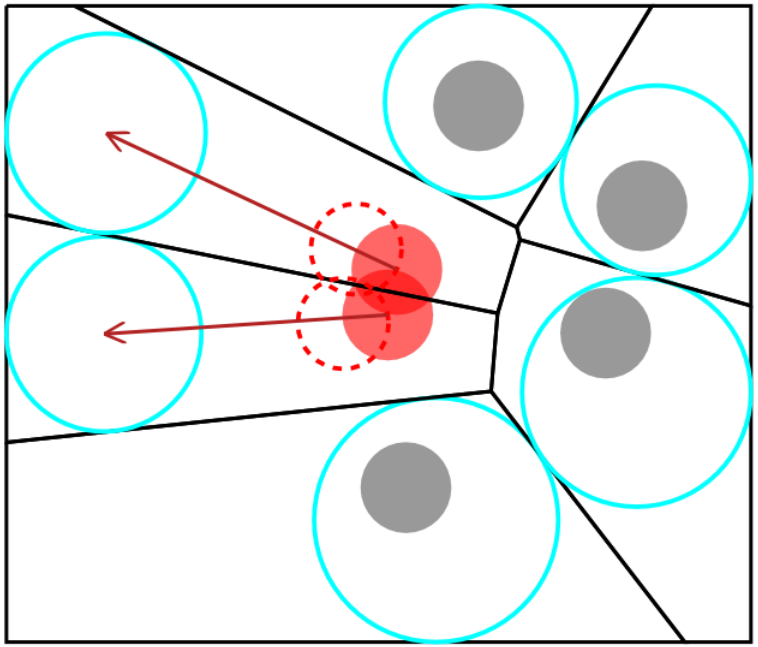
Idea – Voronoi diagram

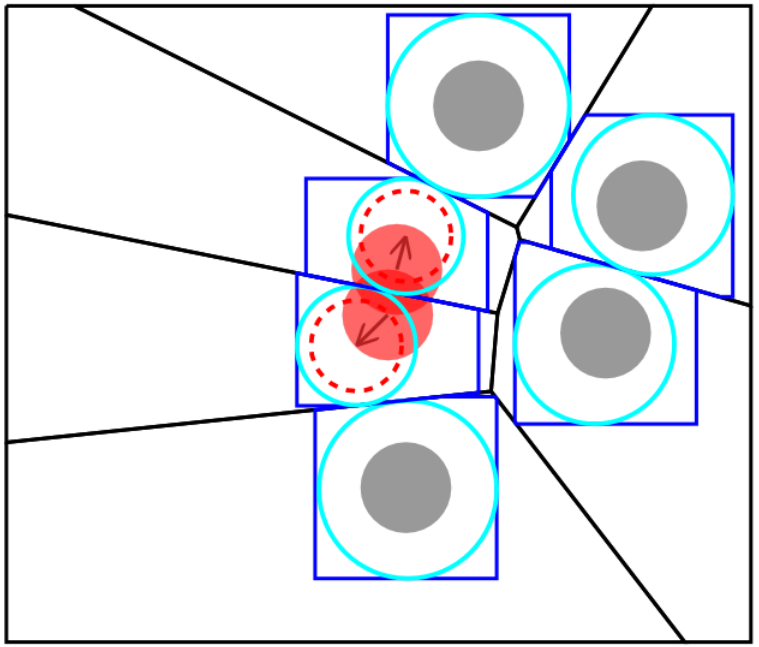
- Assign a distinct area to each point
- Displace point only within its Voronoi cell
  - Map symbol can be placed completely within its Voronoi cell, no new conflicts are introduced
  - Voronoi cell is too small for the map symbol, new conflicts may be introduced



Restriction of displaced distance

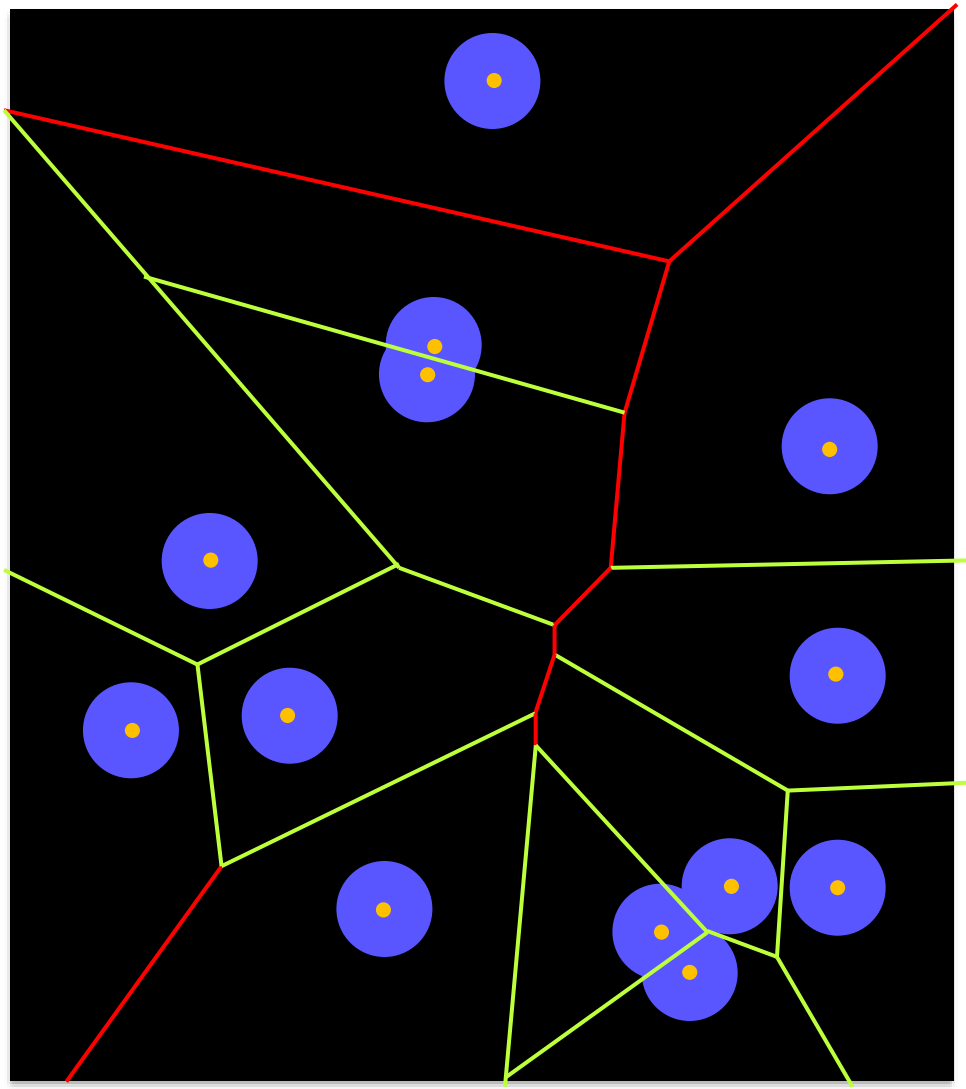
- The coordinates of each point should remain inside the corresponding map symbol
- Apply restriction to the Voronoi cells prior to the heuristics





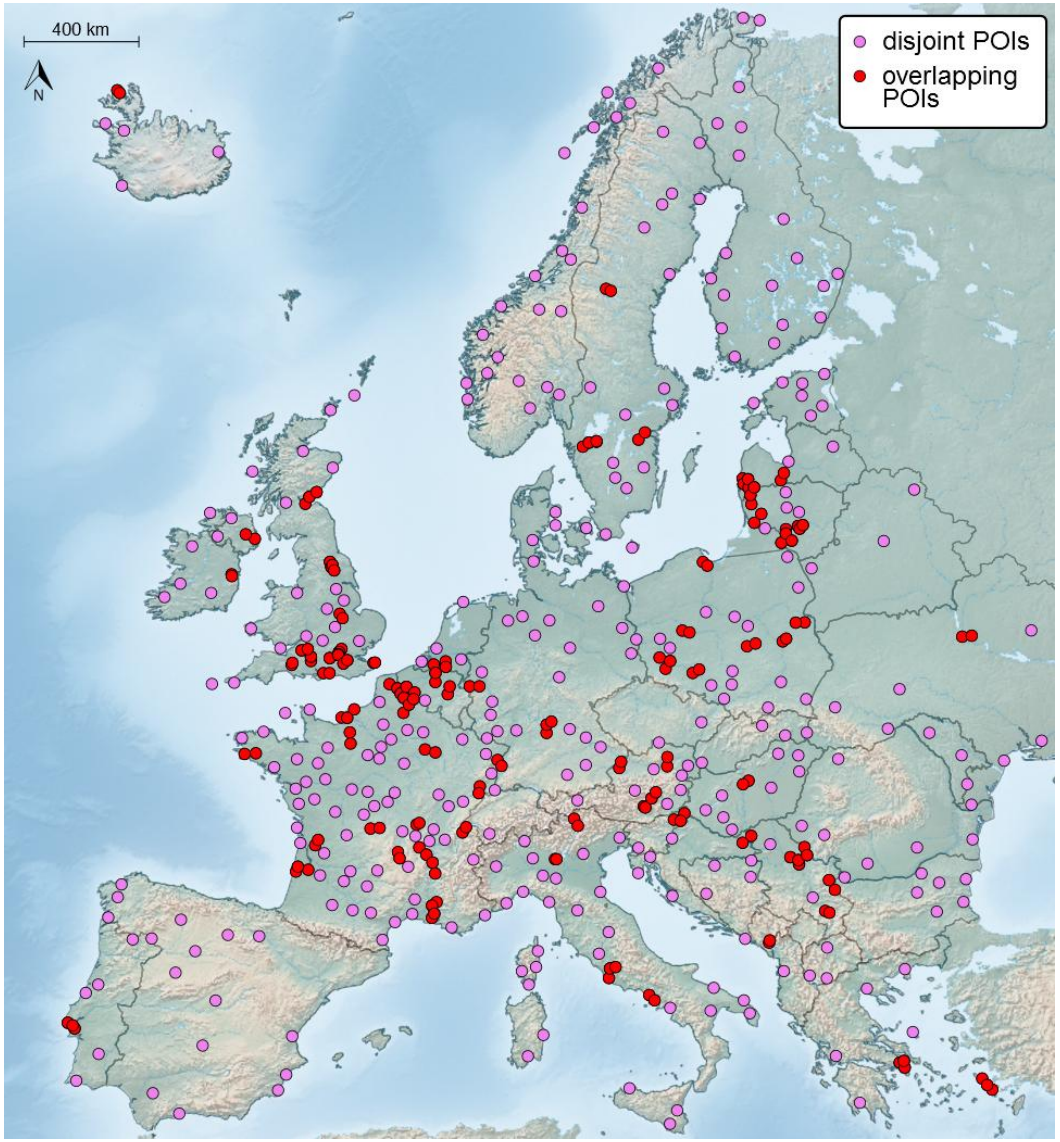
Divide pointset

- Isolated point: distance to nearest neighbor larger than radius of the map symbol
- Split edge: distance to sites larger than radius of the map symbol
- Find a way from border to border along split edges



Testdata

- 10 datasets
  - European towns, airports towers hills, peaks
  - 2 different scales
  - Extracted from geonames
  - Randomly selected points (513/2050)



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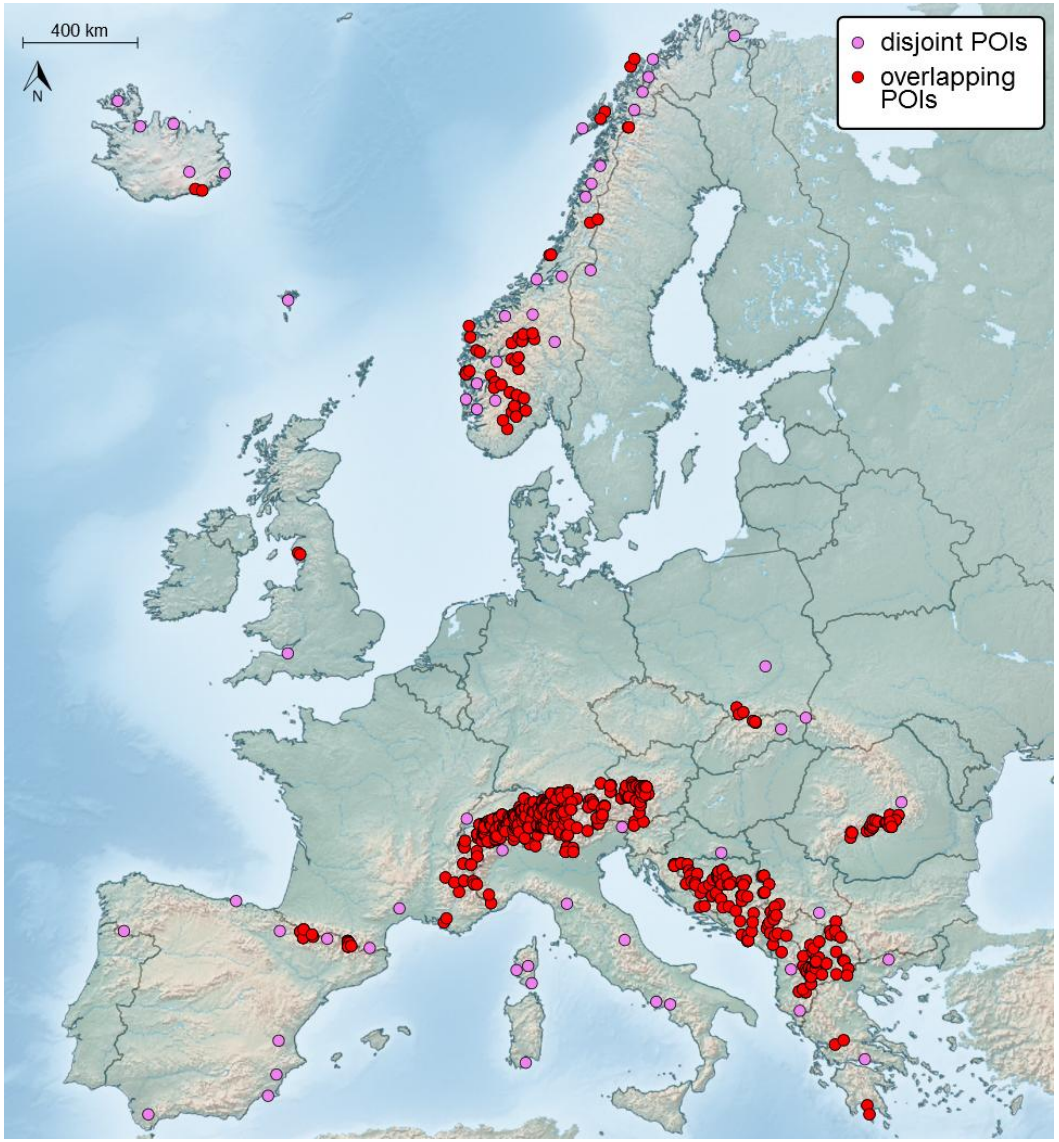
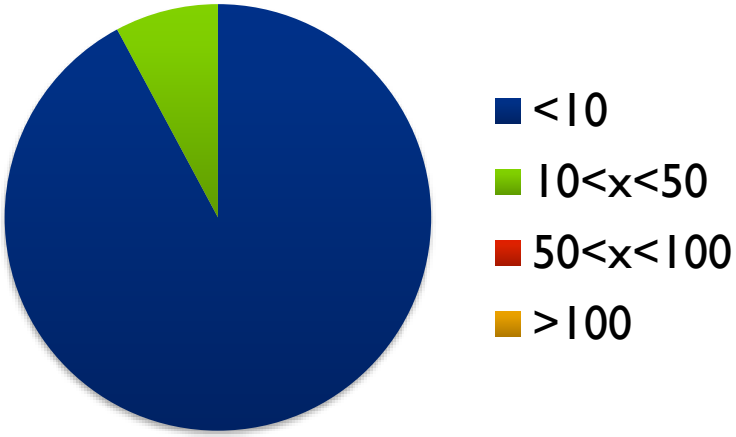
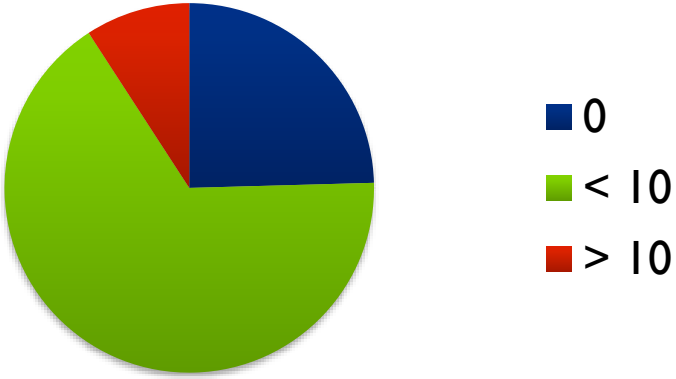


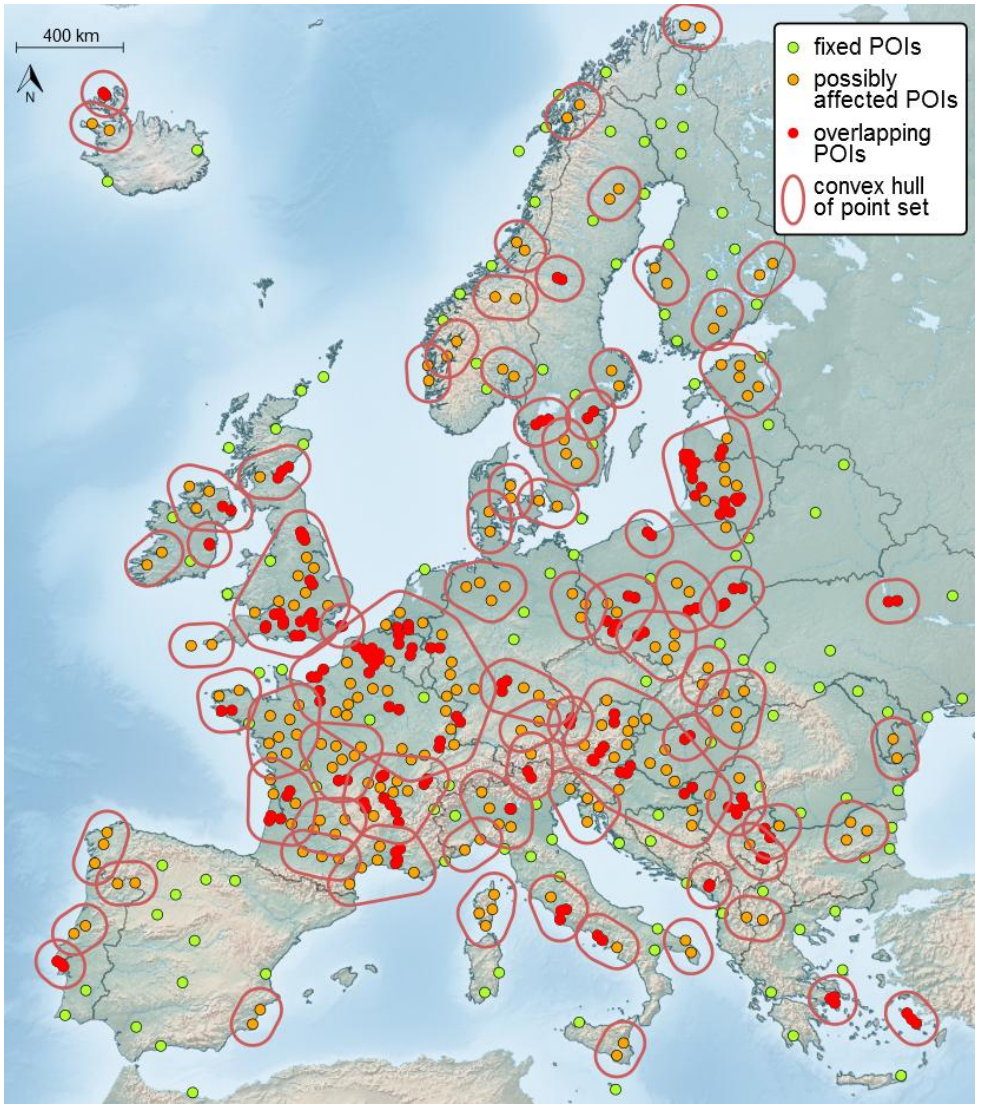
Division - Airport

No of sites per division



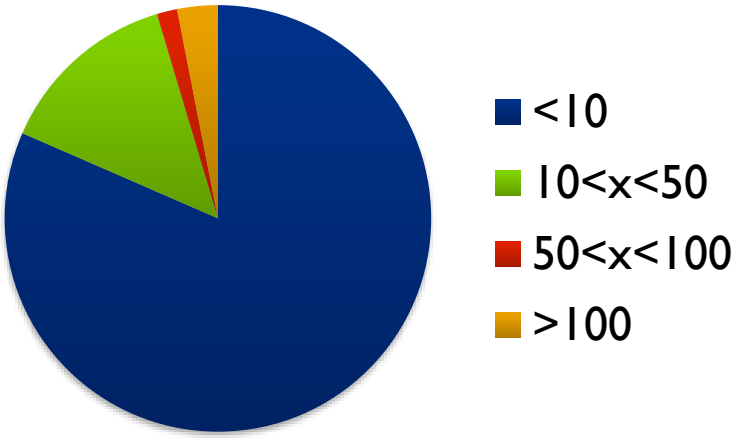
No of iterations





Division - Peak

No of sites per division



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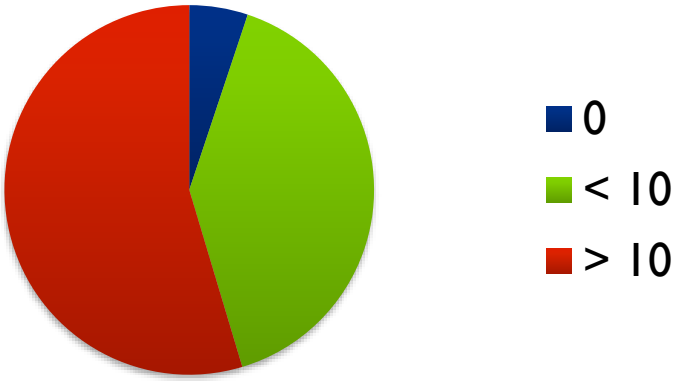
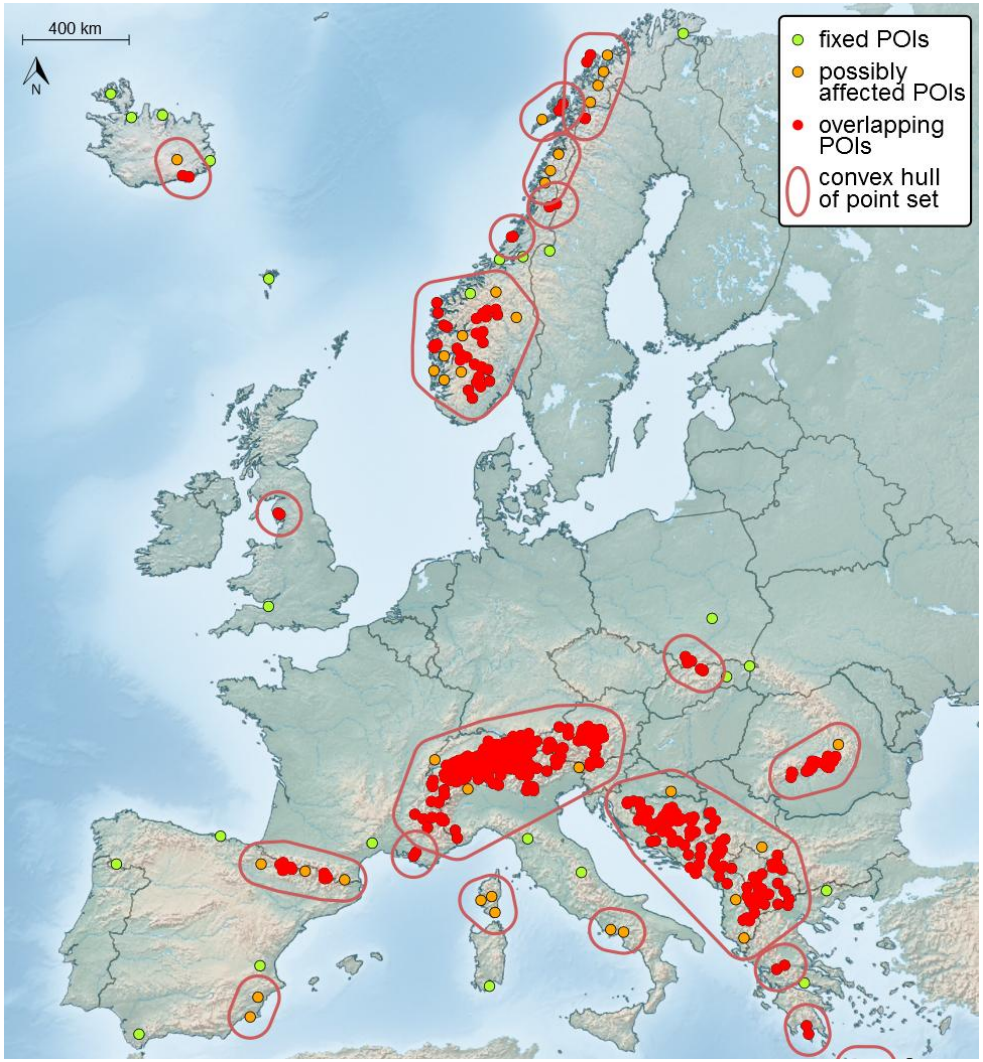
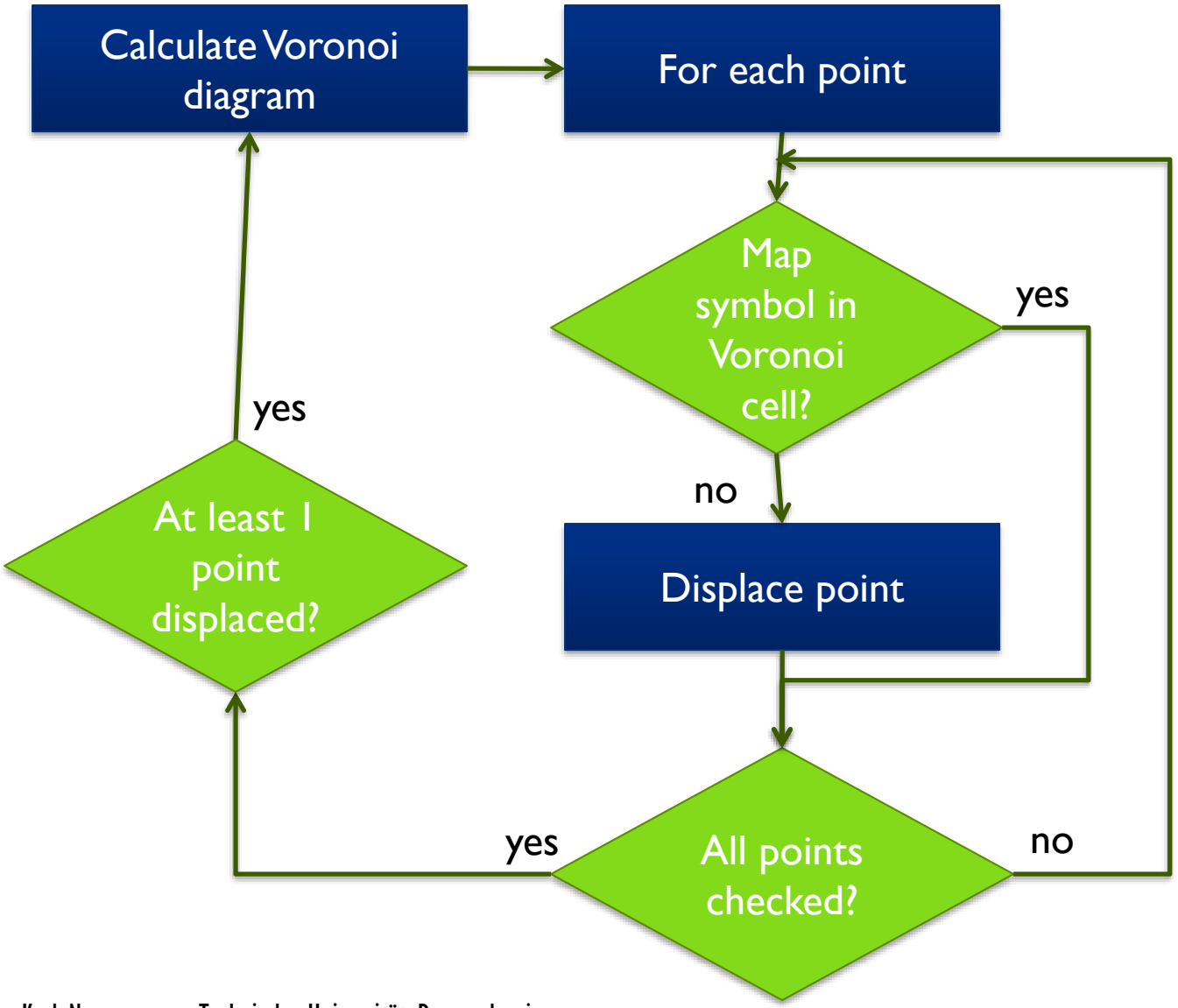


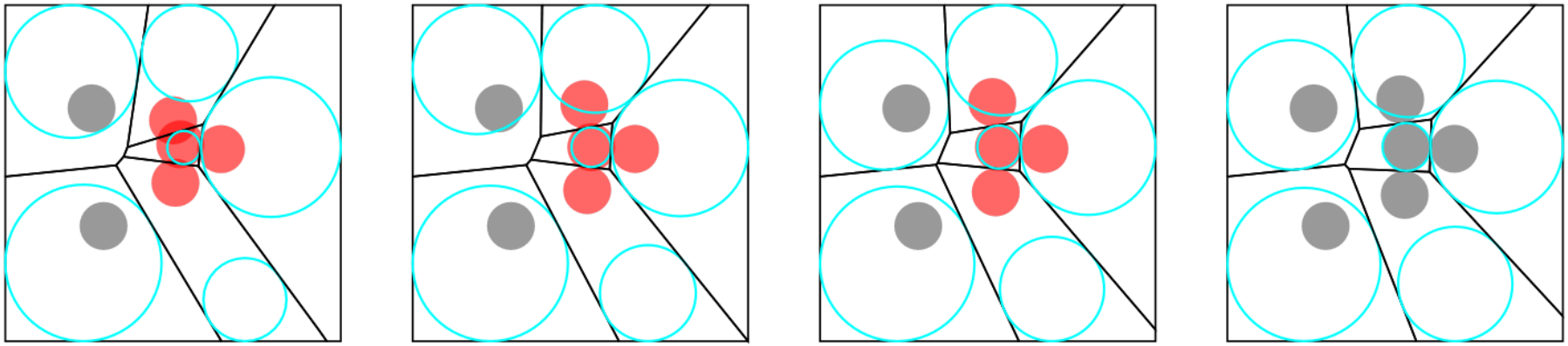


Displacement - Algorithm



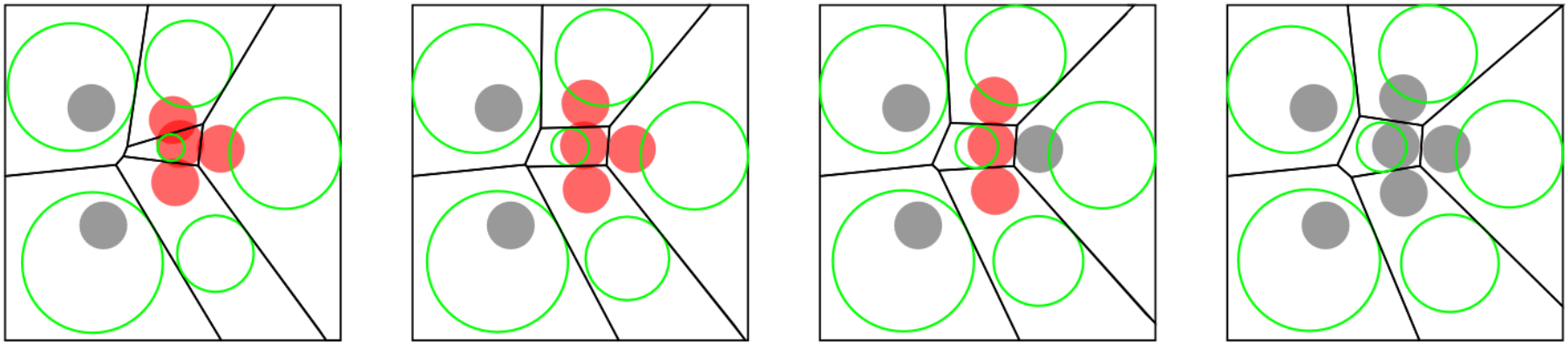
Heuristics for displacement

- Move point towards the center of a largest inner circle of its Voronoi cell
  - Greedy approach
  - Guarantees that the visibility of the least visible symbol is increased in every step

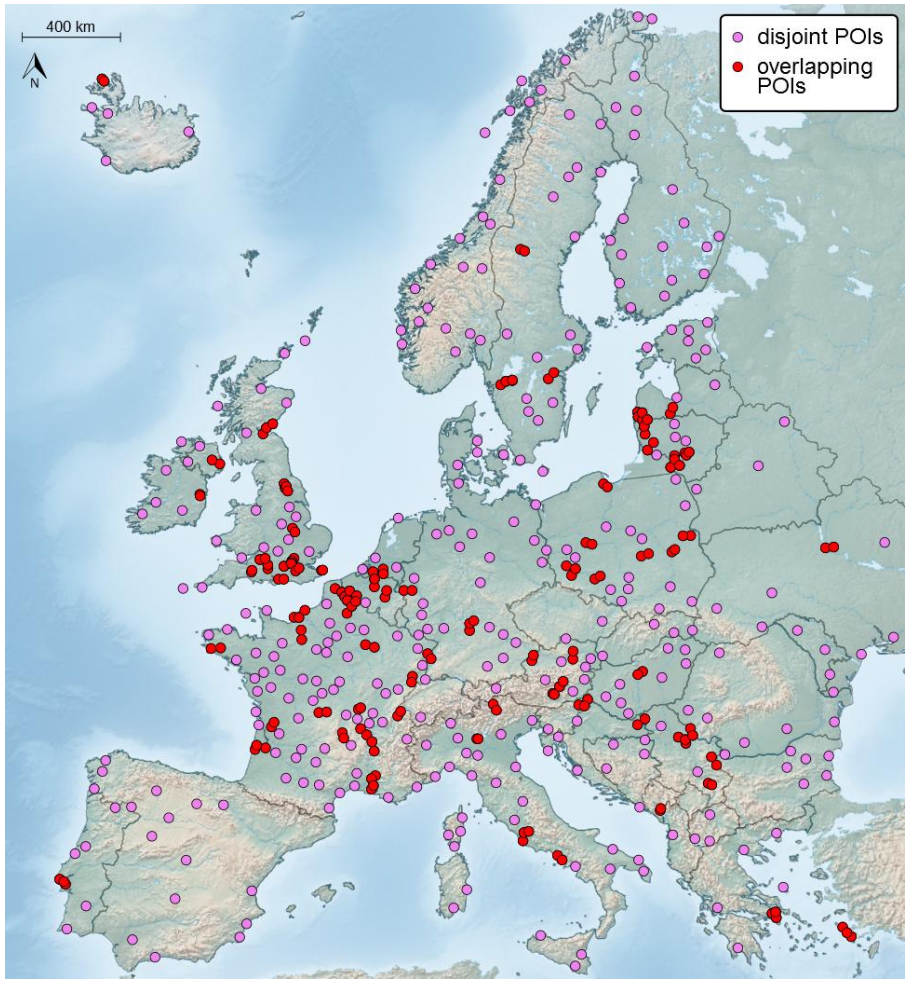


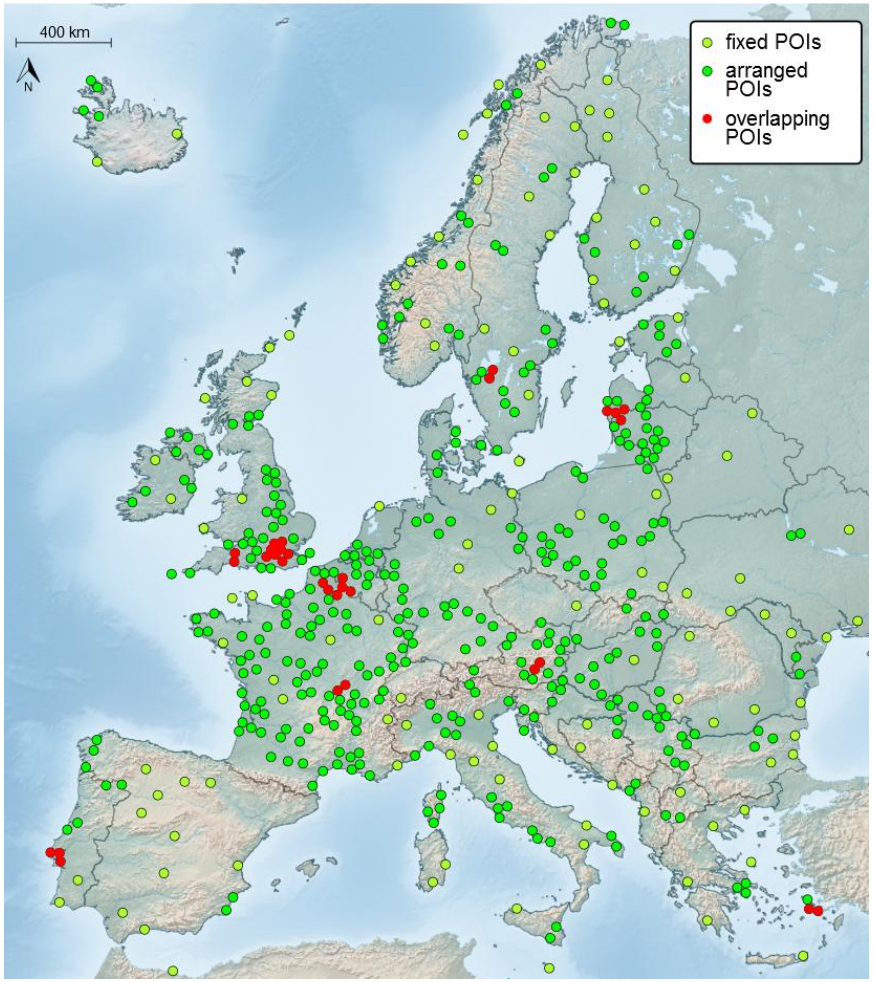
Heuristics for displacement

- Move point towards the centroid of its Voronoi
  - Visibility may be decreased
  - Possible to overcome local optima
  - Centroidal Voronoi diagrams without restriction leads to an optimal distribution of points



Displacement - Result





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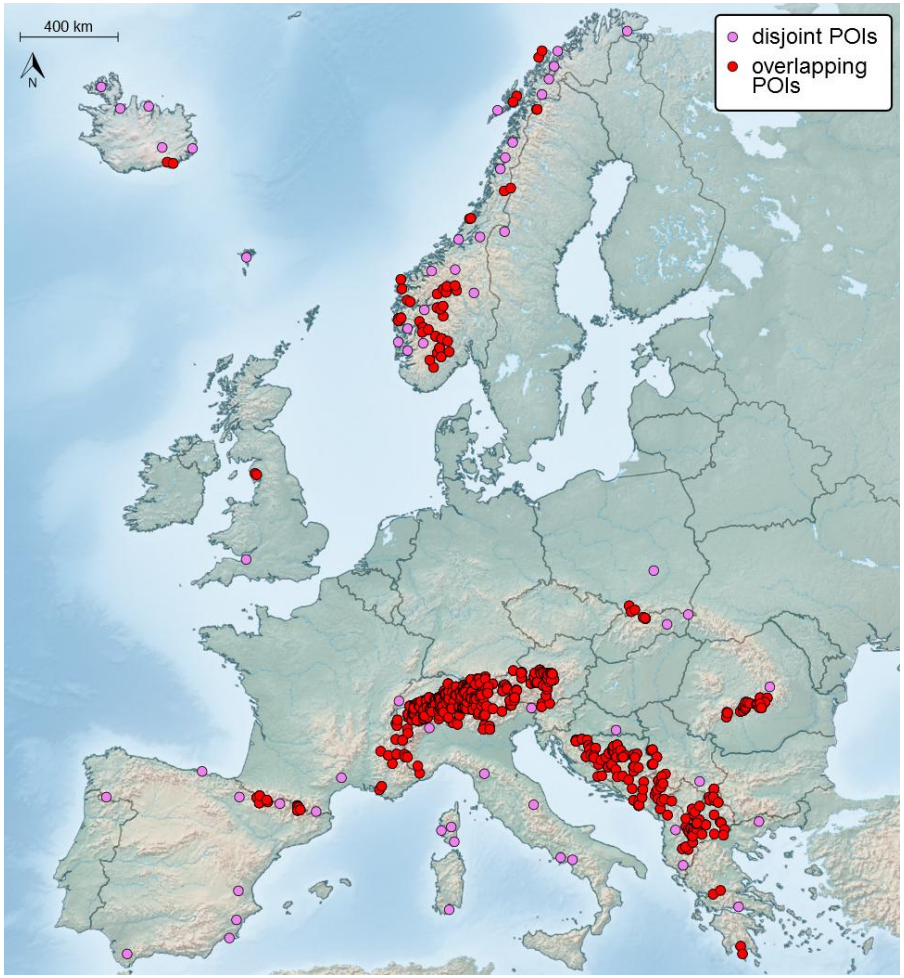
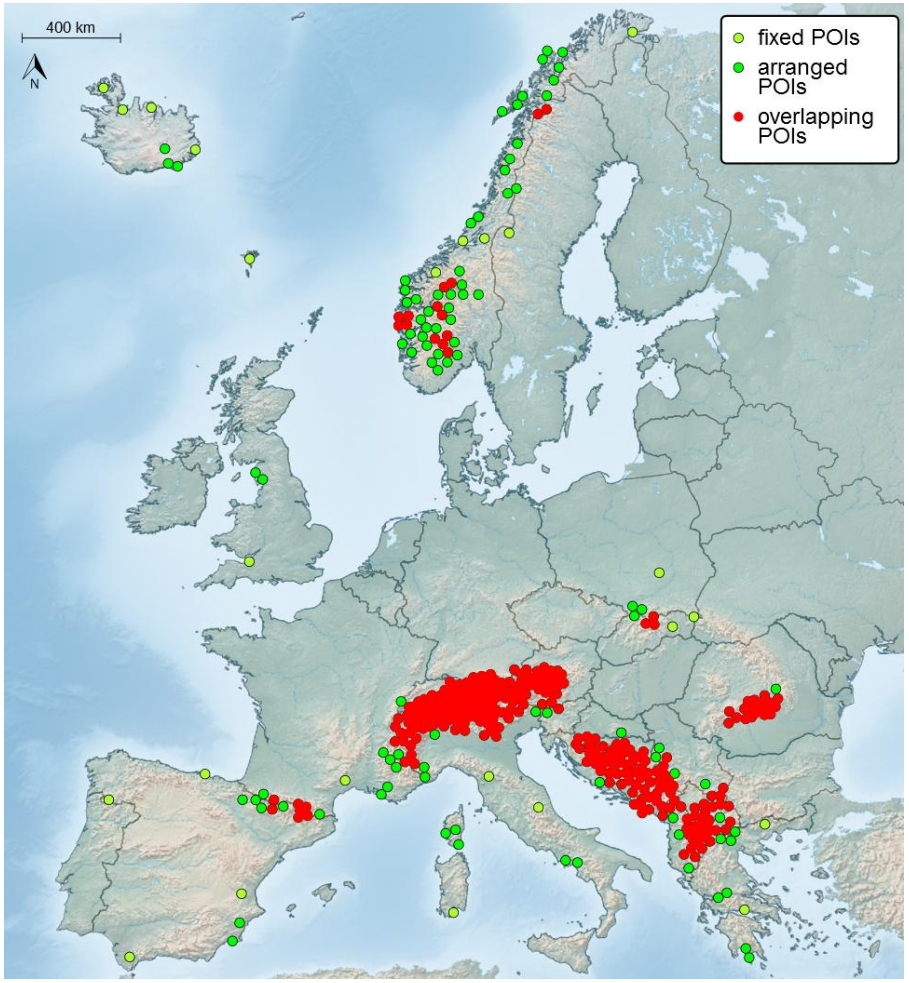
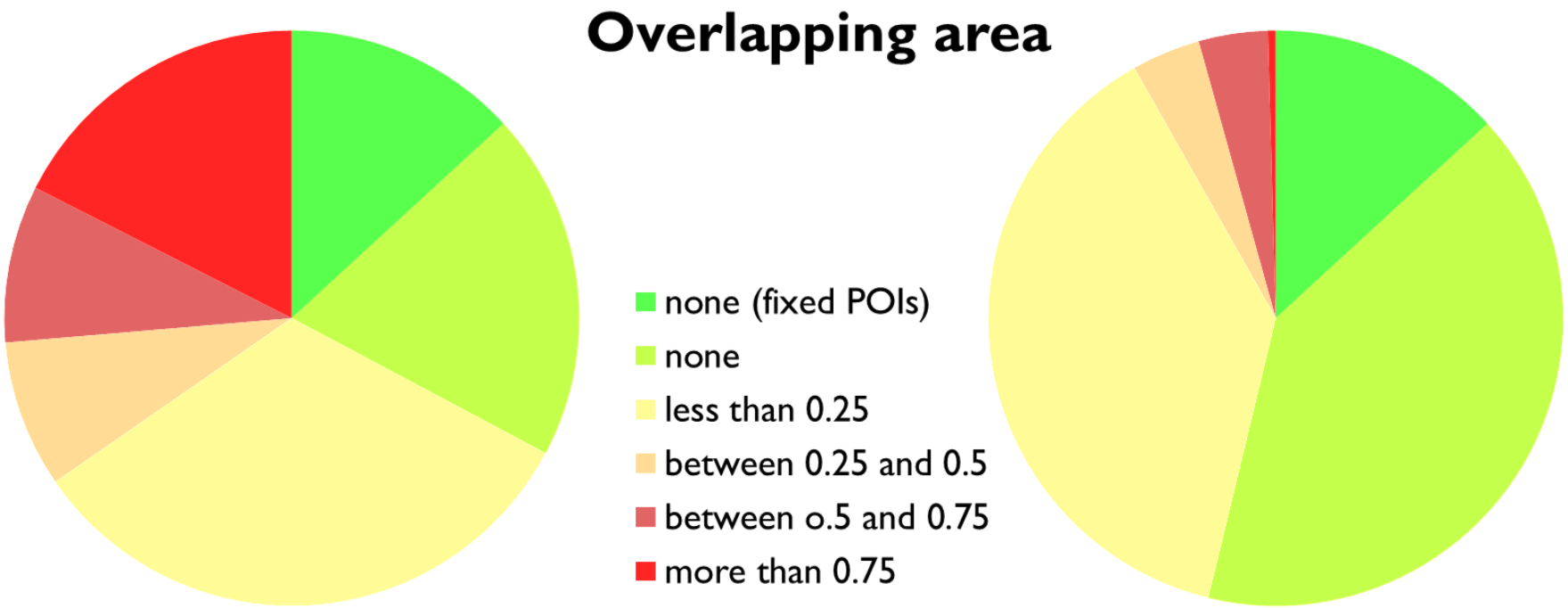




Displacement - Result

- Quality of the placement, measured by the sum of the areas of the intersections of all map symbols.



Future Work

- Analyse properties of point sets
  - Density
  - Solvability
- Test variants of the displacement algorithm
  - Displaced distance per step (minimal, maximal, increasing)
  - Displaced points (only conflicting vs all)