

Spatial Data Infrastructure Days
8th Cartography and Geoinformation Conference

Accuracy research of the map *Sclavonia, Croatia, Bosnia cum Dalmatiae parte* by
G. Mercator

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Introduction



Gerard Mercator
(1512 –1594)



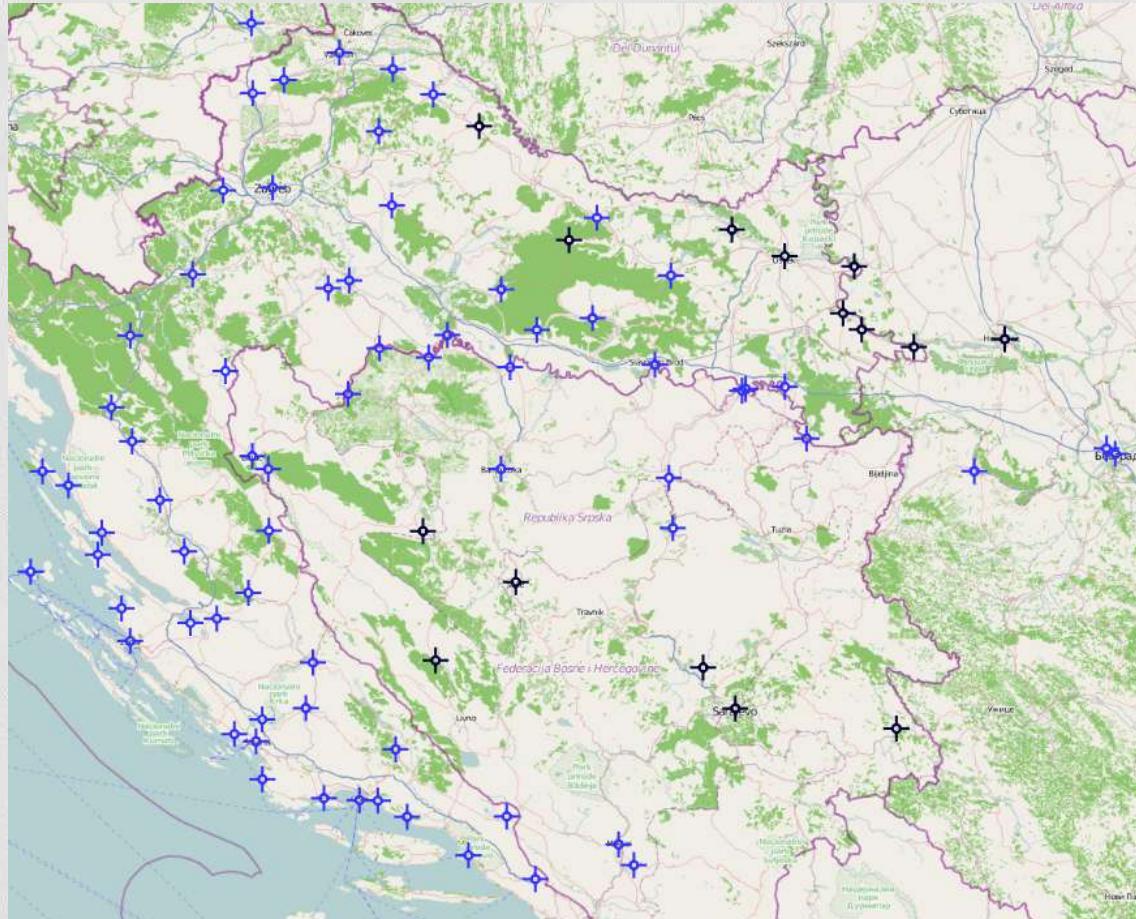
MapAnalyst
The Map Historian's Tool for
the Analysis of Old Maps



A map *Sclavonia, Croatia, Bosnia cum Dalmatiae parte*

Accuracy analysis of the map

Selection of identical points



A segment of OpenStreetMap used for the analysis

Selection of identical points



A segment of a general geographic map used for the analysis

Accuracy analysis of the map

Type of transformations - comparison

	Helmut transformation (4 parameters)	Affine transformation (5 parameters)	Affine transformation (6 parameters)	Robust Helmut transformation (Huber estimator)	Robust Helmut transformation (V estimator)	Robust Helmut transformation (Hampel estimator)
Standard deviation in destination map [m] OSM	28 351,682	28 412,251	14 014,132	10 272,338	9 306,904	9 862,108
General geographic map	28 375,317	28 470,125	13 953,284	10 218,549	9 414,672	10 695,471
Standard deviation in source map [m] OSM	0,029	0,029	0,015	0,011	0,010	0,011
General geographic map	0,029	0,029	0,015	0,011	0,010	0,012

	Helmert transformation (4 parameters)	Affine transformation (5 parameters)	Affine transformation (6 parameters)	Robust Helmert transformation (Huber estimator)	Robust Helmert transformation (V estimator)	Robust Helmert transformation (Hampel estimator)
Root mean square position error in destination map [m] OSM	40 095,333	40 180,991	19 818,975	14 527,279	13 161,950	13 947,126
General geographic map	40 128,758	40 262,837	19 732,923	14 451,211	13 314,356	15 125,680
Root mean square position error in source map [m] OSM	0,041	0,041	0,021	0,016	0,014	0,015
General geographic map	0,041	0,041	0,021	0,016	0,015	0,017
Number of identical points OSM	82	82	69	56	54	55
General geographic map	82	82	69	56	54	56

Accuracy analysis of the map

Reference maps

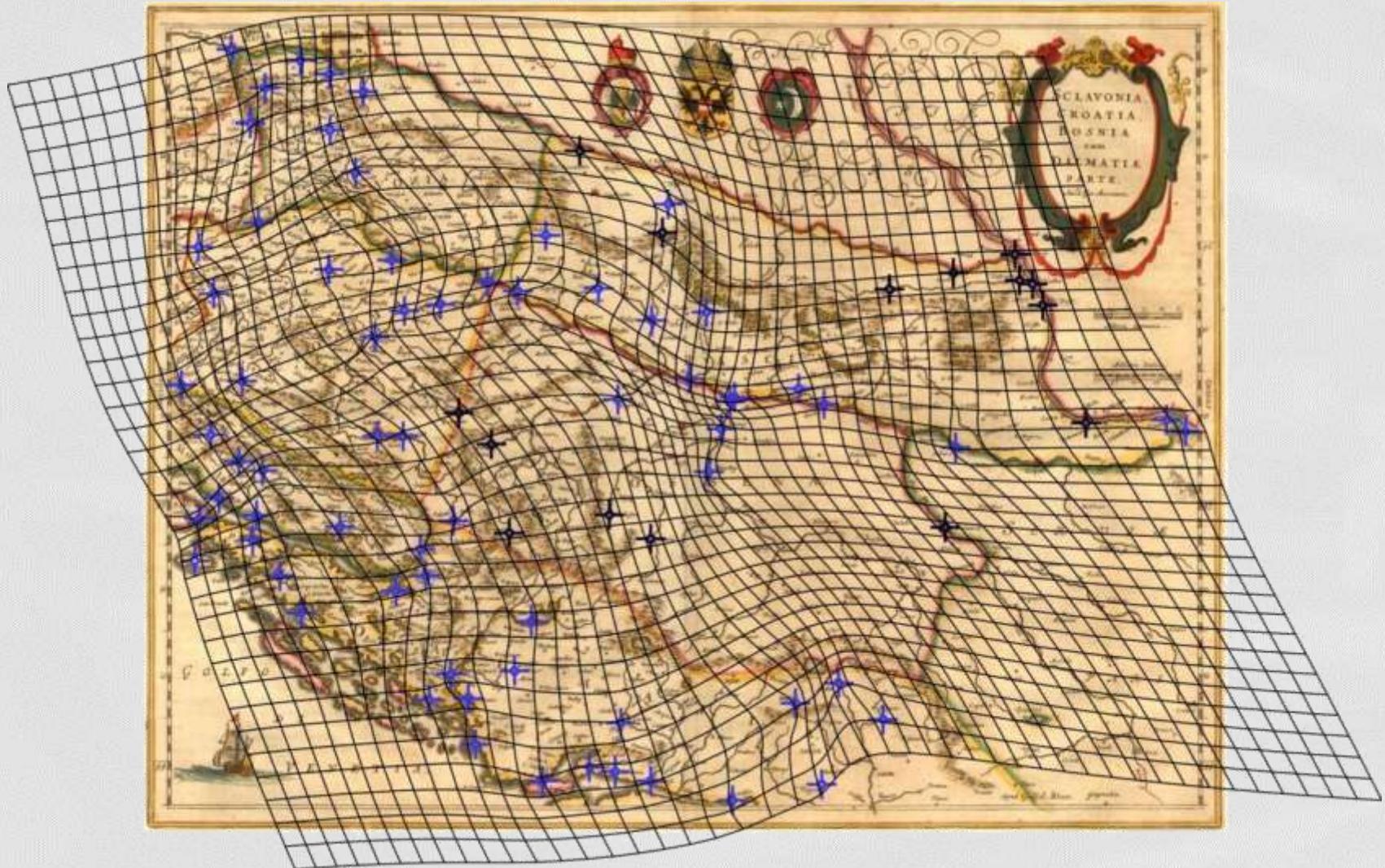
- OpenStreetMap
- General geographic map at the scale 1:1 000 000 in a modified polyconic projection with the ellipsoid adapted for the international map of the world
- An example – affine transformation with 6 parameters

Accuracy analysis of the map

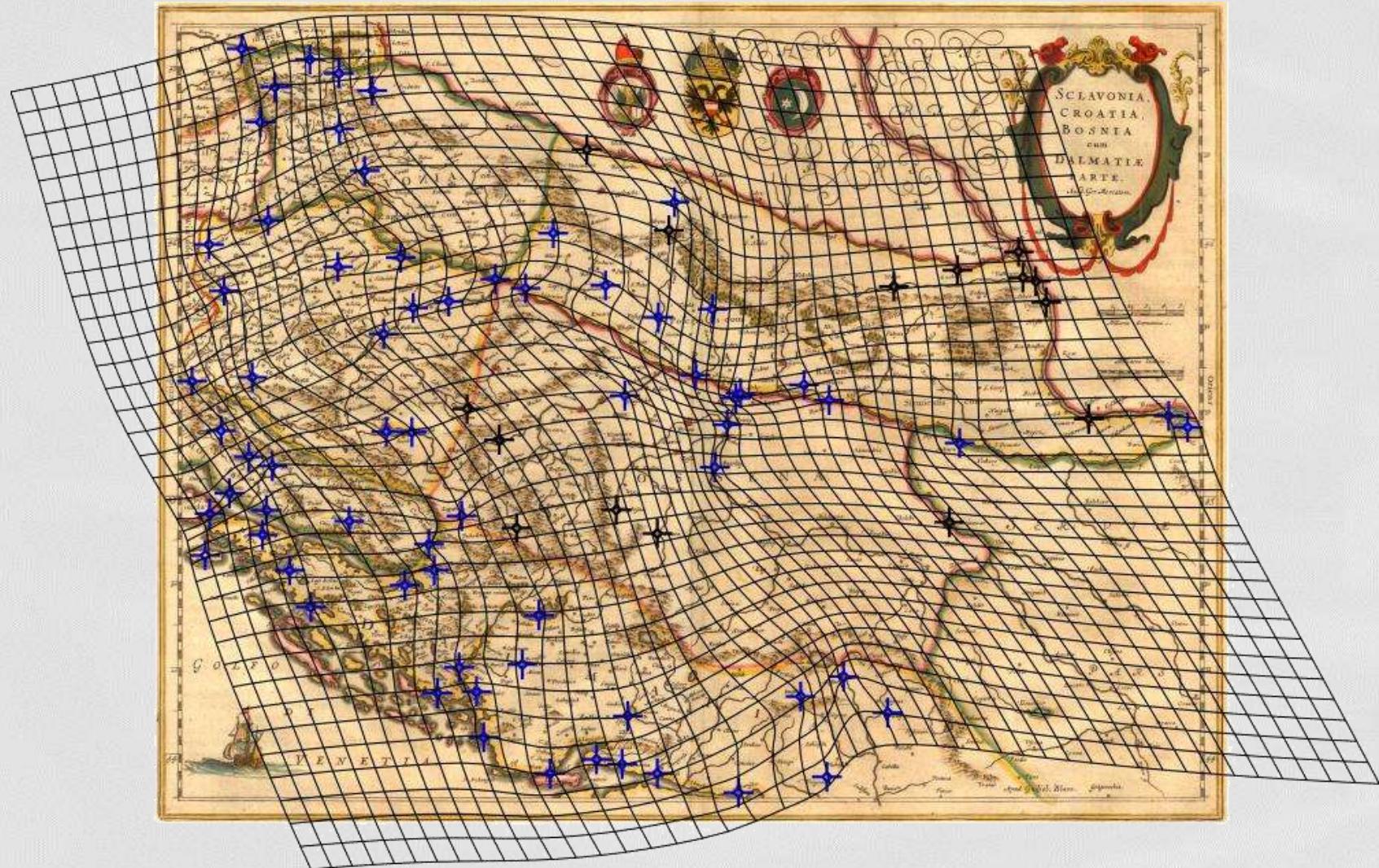
Distortion grid

- Meshes of a distortion grid, with the size $10\ 000 \times 10\ 000$ meters, reflect the local deformation and rotation of Mercator's map.
- OpenStreetMap – rotation 13° , scale 1: 950 000
- General geographic map – rotation 14° , scale 1: 948 000
- Calculated scale – 1:916 000

Distortion grid – OpenStreetMap



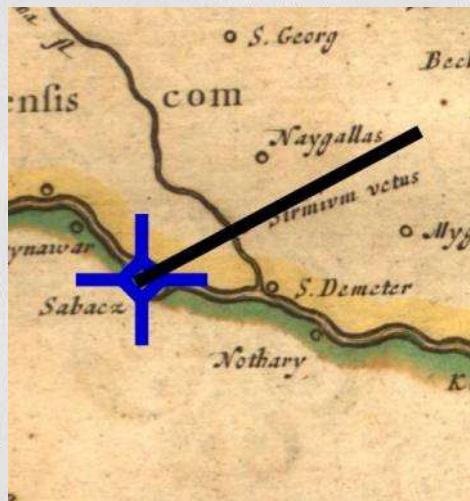
Distortion grid – General geographic map



Accuracy analysis of the map

Displacement vectors

- Each vector line starts at a point previously identified in the old map and ends at the position where the point would be if the old map was as accurate as modern reference map.



Displacement vectors - OpenStreetMap



Location	Correction [cm] Mercator's map
Medak	0,3
Karlobag	0,3
Šibenik	0,3
Pag	0,4
Drniš	0,4
Silba	0,6
Makarska	0,7

Location	Correction [cm] Mercator's map
Slatina	4,4
Mostar	4,3
Imotski	3,5
Šabac	3,4
Blagaj	3,3
Stara Gradiška	3,3
Našice	3,1

Displacement vectors - General geographic map



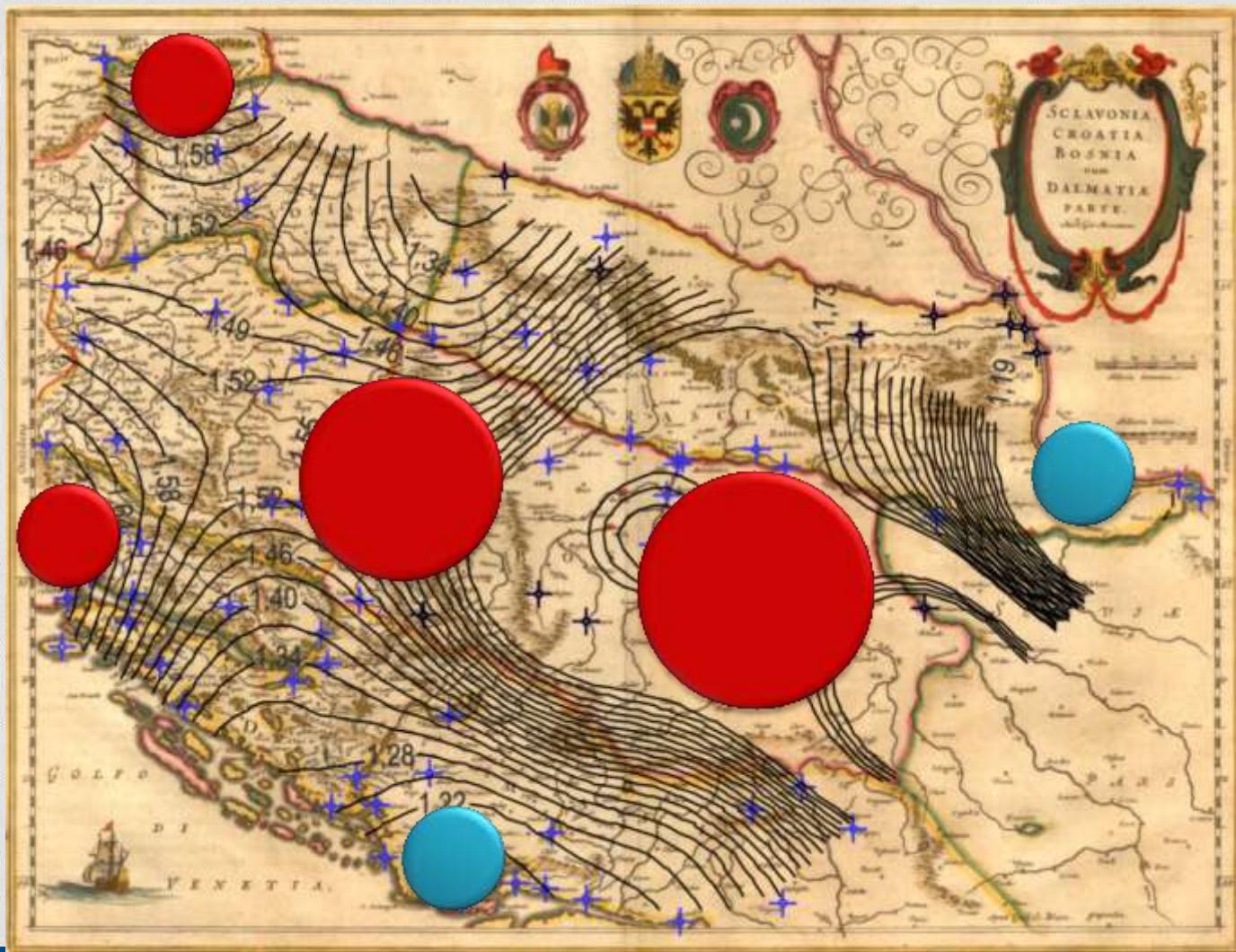
Location	Correction [cm] Mercator's map
Medak	0,3
Karlobag	0,4
Šibenik	0,4
Pag	0,4
Drniš	0,4
Silba	0,6
Makarska	0,7
Location	Correction [cm] Mercator's map
Mostar	4,4
Slatina	4,3
Imotski	3,6
Blagaj	3,4
Šabac	3,3
Našice	3,2
Stara Gradiška	3,2

Accuracy analysis of the map

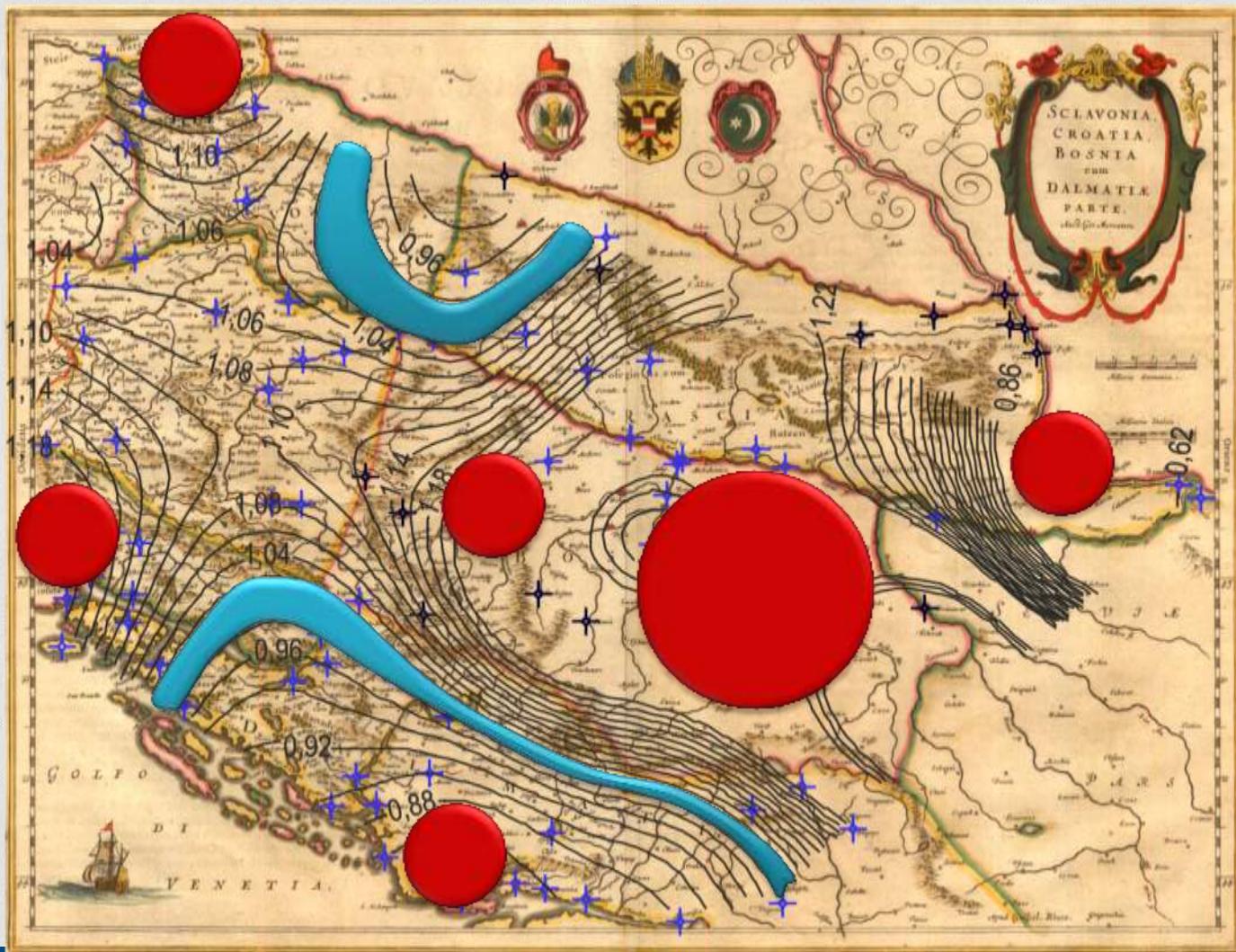
Isolines of scale and rotation

- New means of visualizing local variations
- Connect points of constant scale or rotation
- Illustrate how scale and rotation locally change in the map

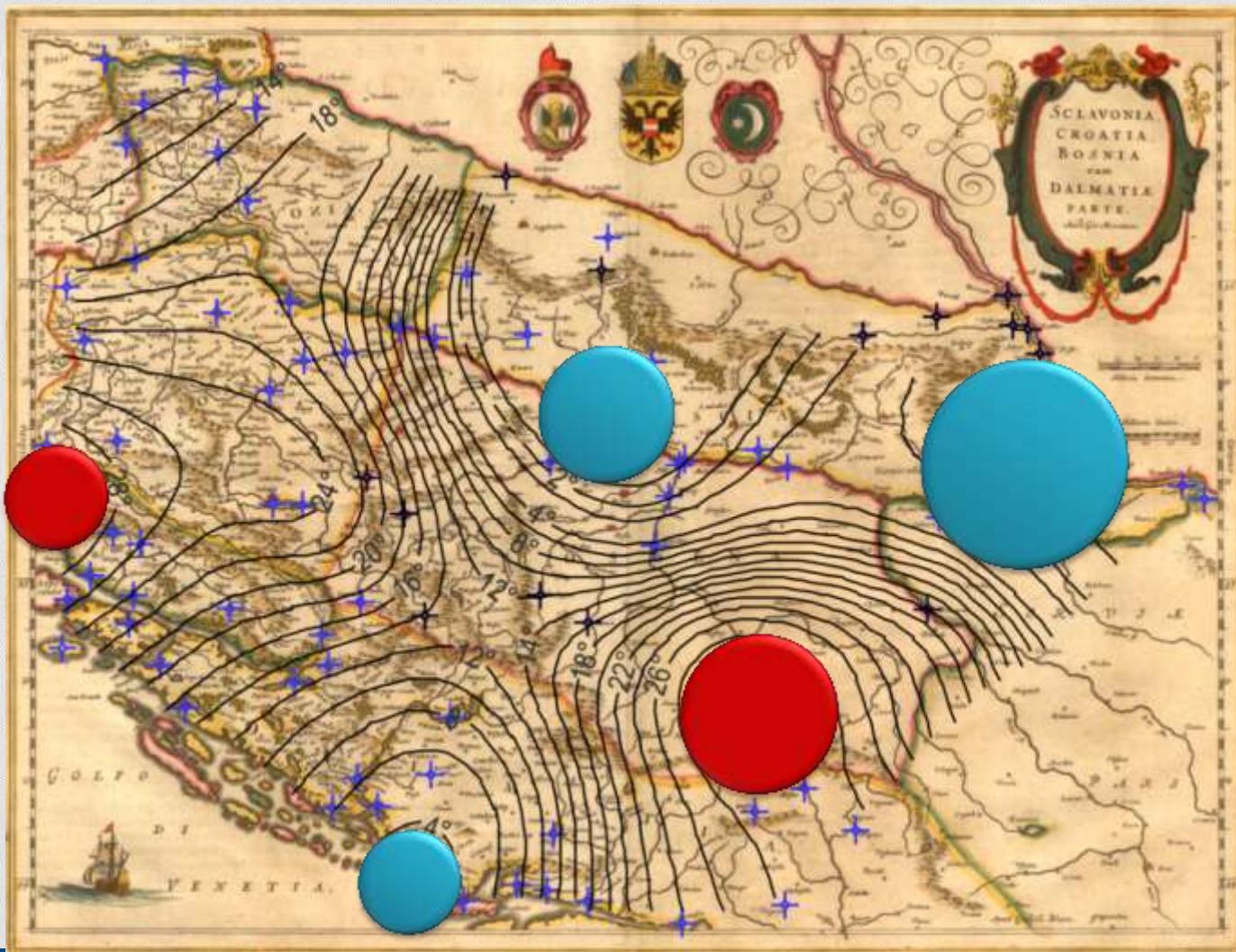
Isolines of scale - OpenStreetMap



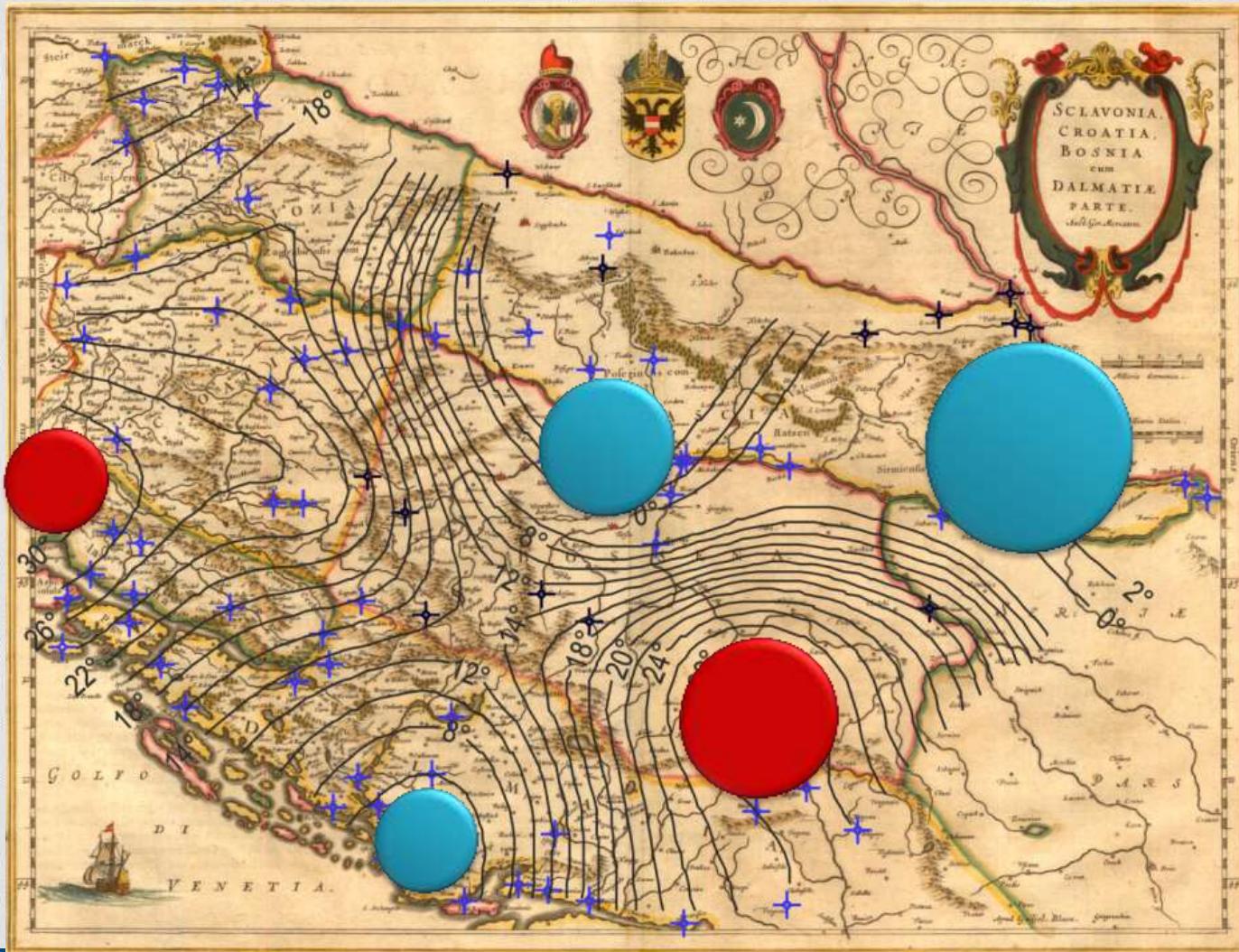
Isolines of scale - General geographic map



Isolines of rotation - OpenStreetMap



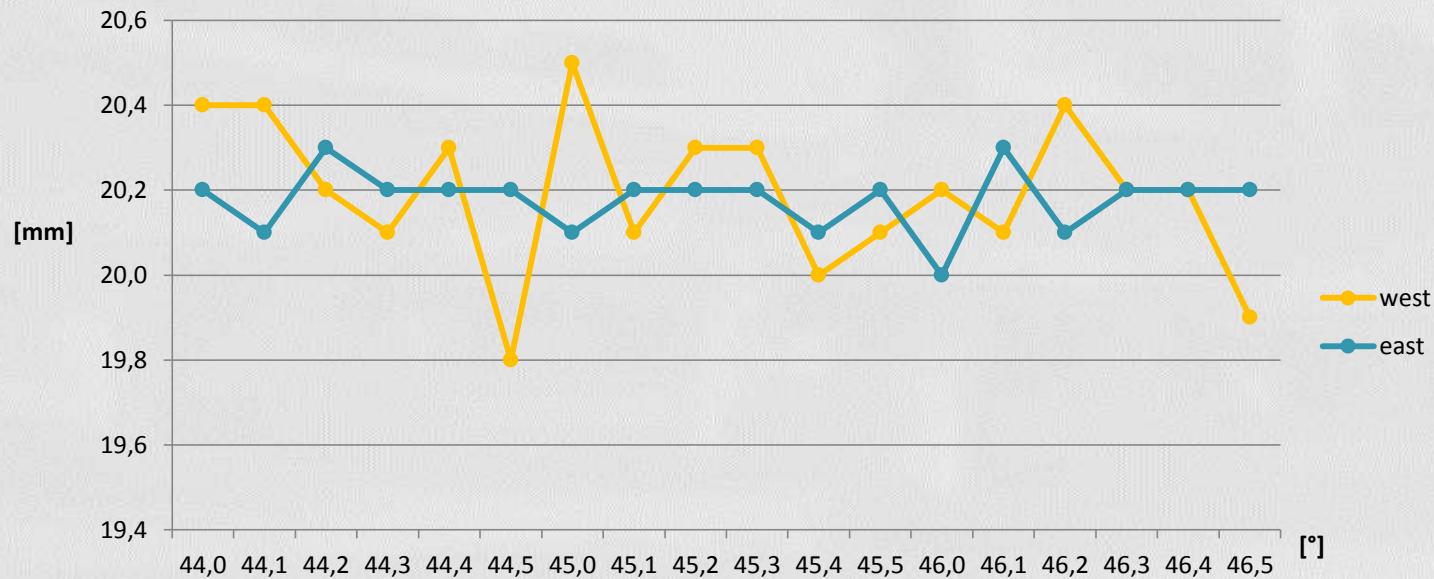
Isolines of rotation - General geographic map

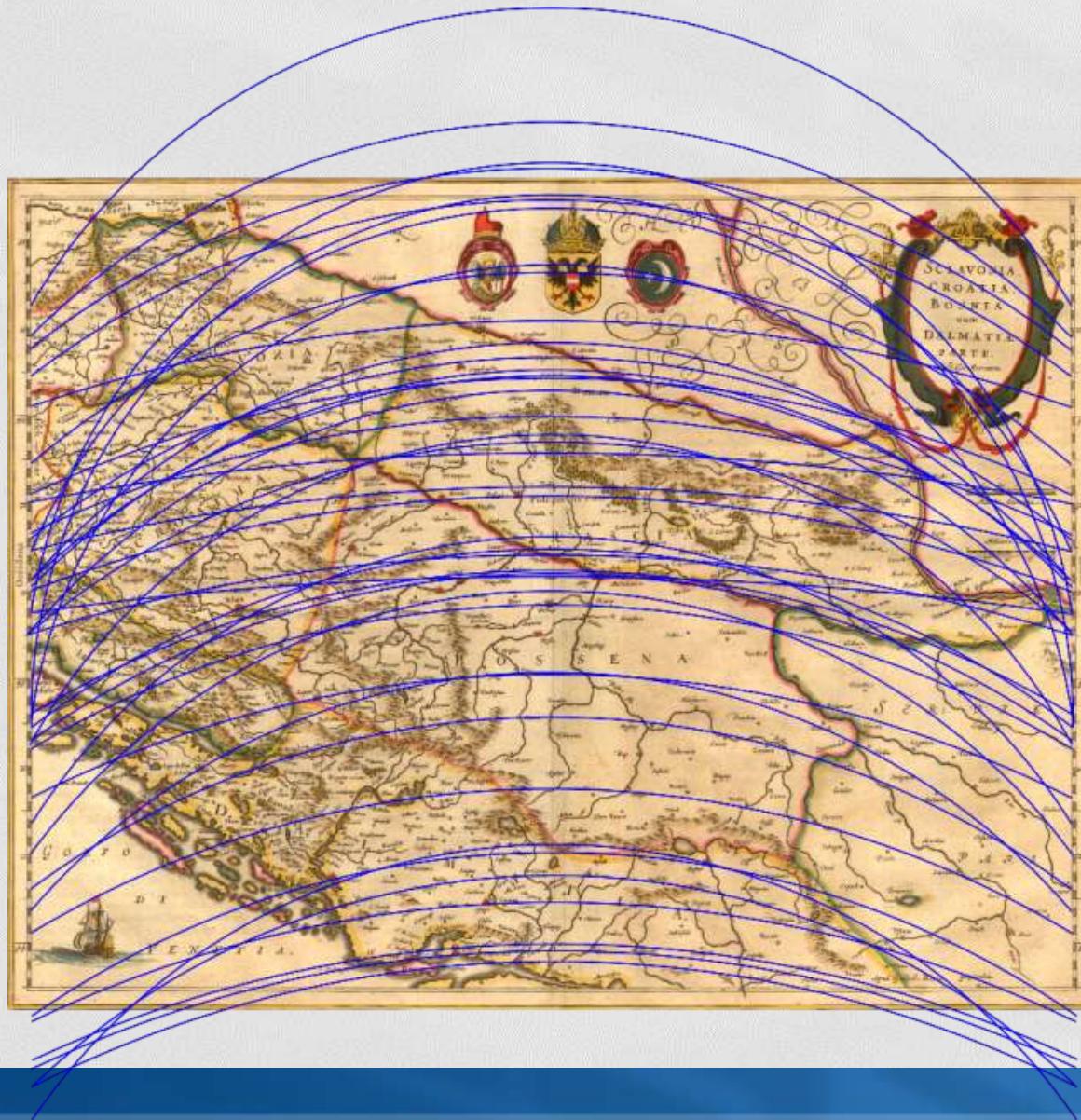


Instead of Conclusion

- It would be necessary to perform further tests to verify if this example with affine 6 parameters transformation is valid.
- Probably, none of selected factors would considerably influence the result of the cartometric analyses.
- A map projection of Mercator's map?

Differences between west and east scale of the map





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Thank you for attention!