The sampling of the Eurasia intraplate velocities using the EPN stations

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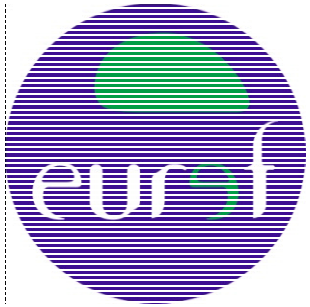
Background/Abstract



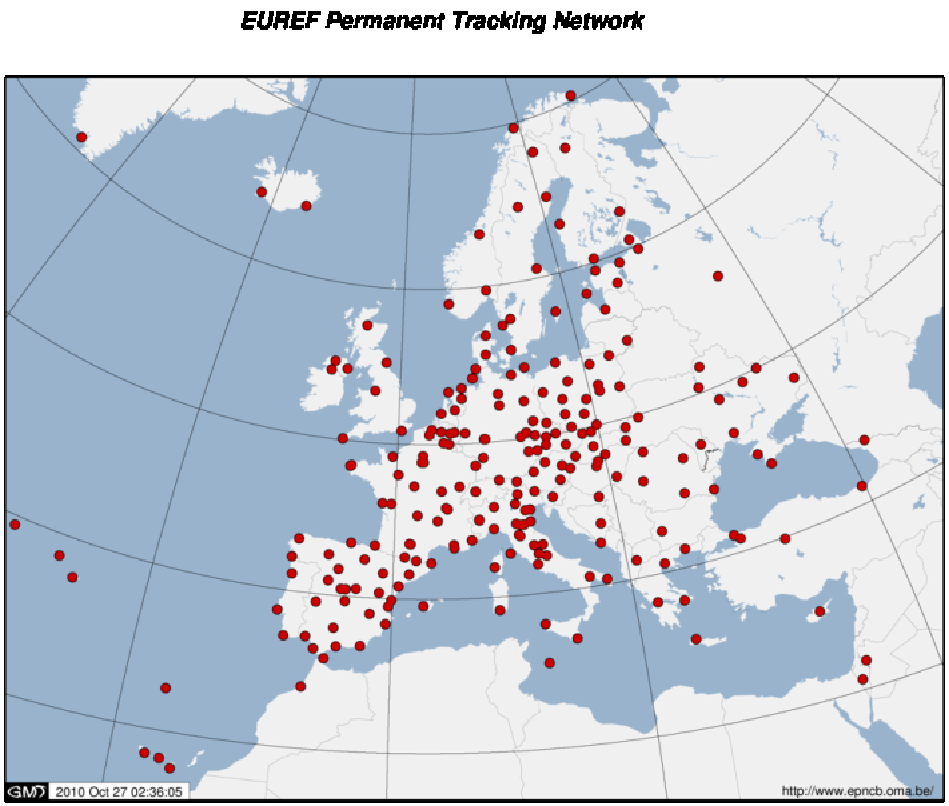
The European Terrestrial Reference System ETRS89 makes reference to the 'stable part' of Europe, in the sense that the velocities of geodetic markers in reference frames realized according to the ETRS89 are very nearly zero. Because of the presence of deformation zones, residual non zero velocities (horizontal and vertical) relative to the Eurasian pole do exist in various parts of Europe. In many aspects, the knowledge of these intraplate velocities are important, e.g. when deciding on maintenance, realization, and procedures for the use of ETRS89.

In 1996, the EUREF Permanent Network (EPN) was established. This array of permanent GNSS stations has developed continuously during its 15 years history and includes today some 250 stations. Thanks to the grate effort invested in the operation and analysis, the EPN is an excellent tool for studying the intraplate deformations within the Eurasia tectonic plate as well as deformation zones in its adjacent areas.

In this presentation we study how well computed velocities at the EPN stations do sample the velocities within "geographical scope" of EUREF by comparing velocities between neighboring stations. We also use a graphical tool to visualize these velocity differences. The result indicate areas where it seems that the physical phenomenon are sufficiently well observed, and other areas where additional observations are needed

Outline

1. Permanent GNSS stations in Europe
2. Development among users
3. Recall lifetime of ETRS89 (Caporali et al.)
4. Investigate intraplate velocities at EPN sites
5. Possible improvements by using a (geophysically based) deformation model

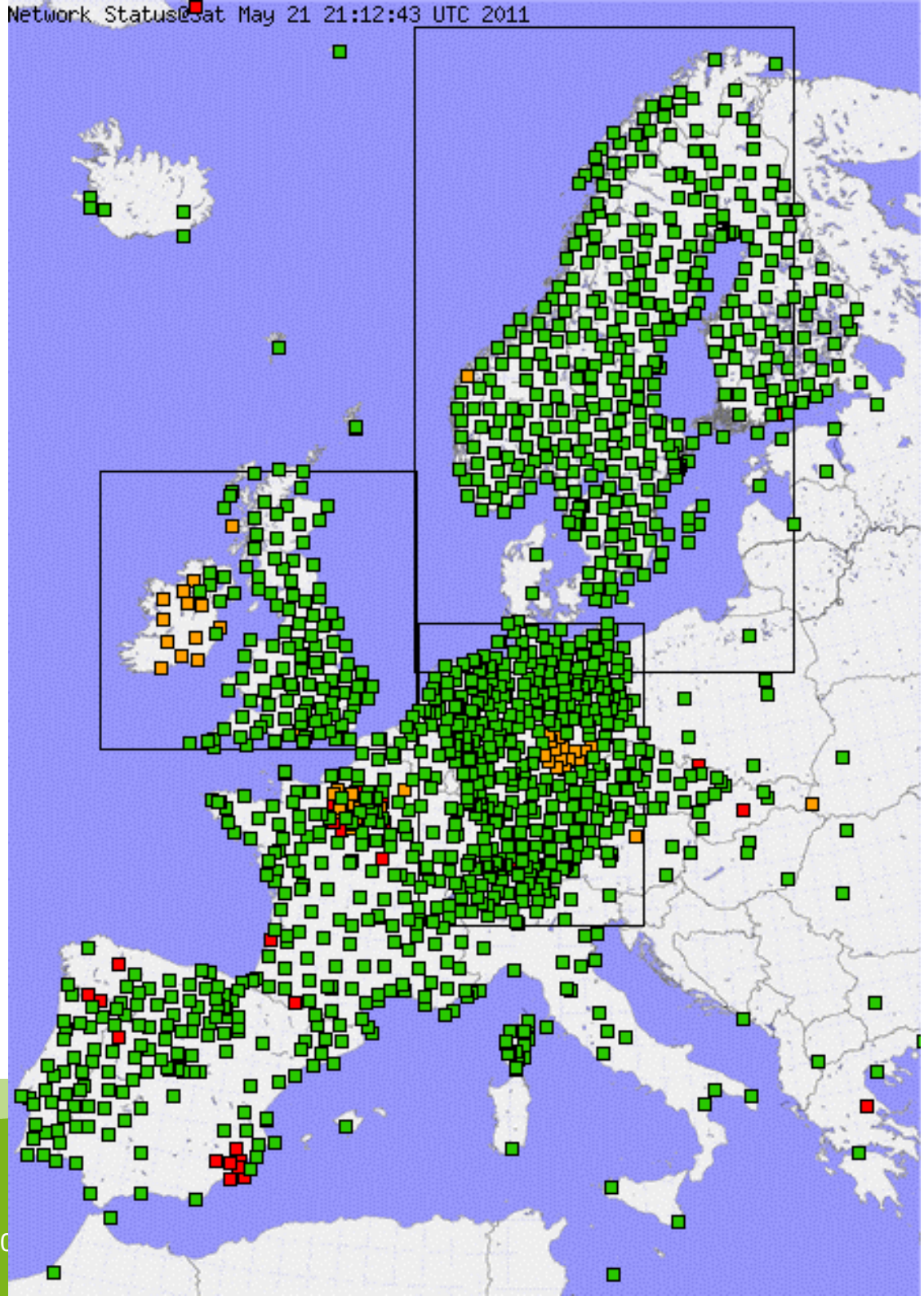


There are nowadays many permanent GNSS stations within Europe!

Map from http://egvap.dmi.dk/

Similar high density of stations also exist in south and east parts of Europe.

Development often driven by Network RTK services

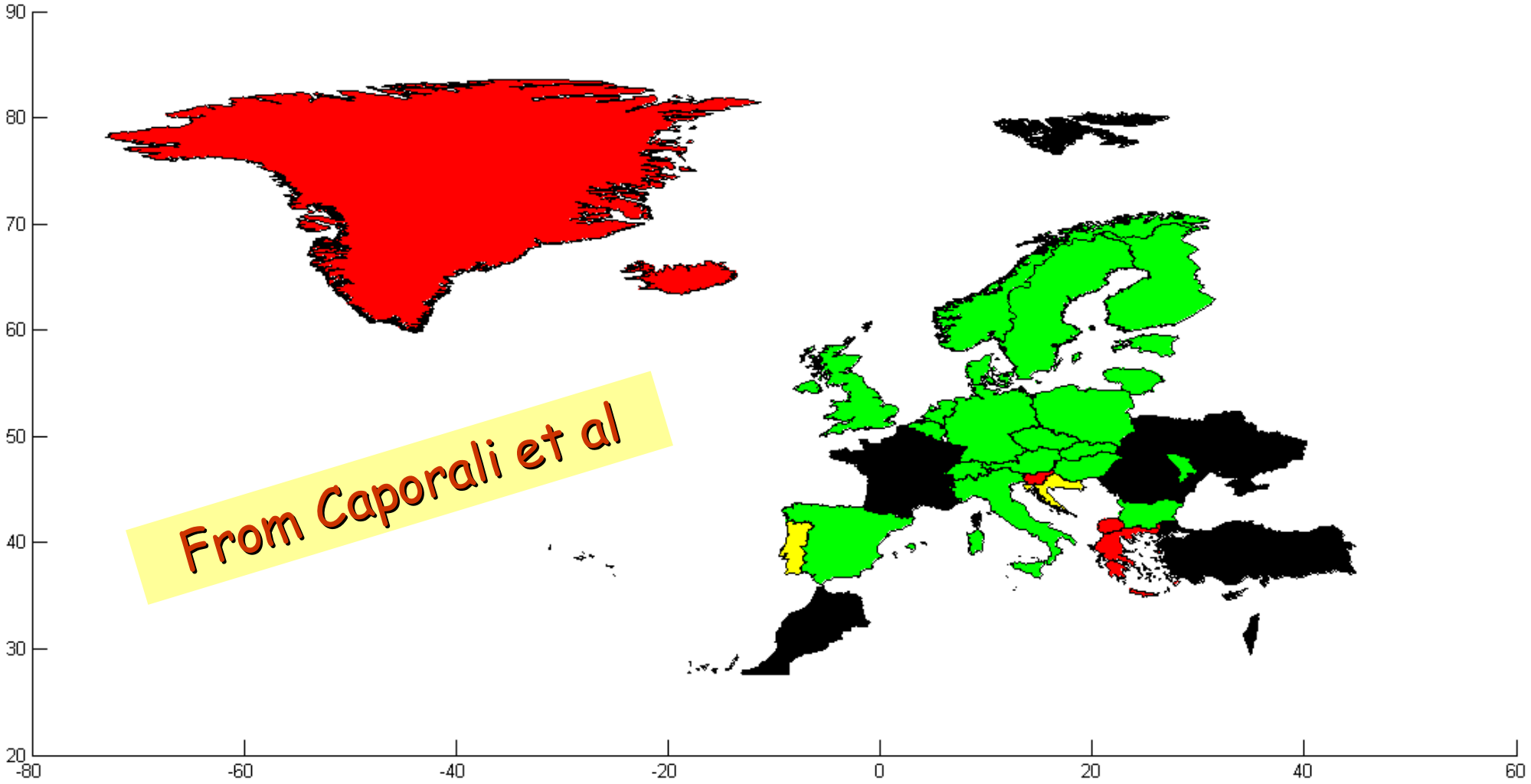


Development in the user segment of precise geodetic infrastructure

→From experienced geodesists and surveyors to users where the precise positioning is an integrated part of the guidance or automatic control of the machine

"the black box should just work and give me the support I have paid for"

Predict when local horizontal velocities generate discrepancy from frame > 3 cm



No realization | <2012 | >2012 <2020 | >2020

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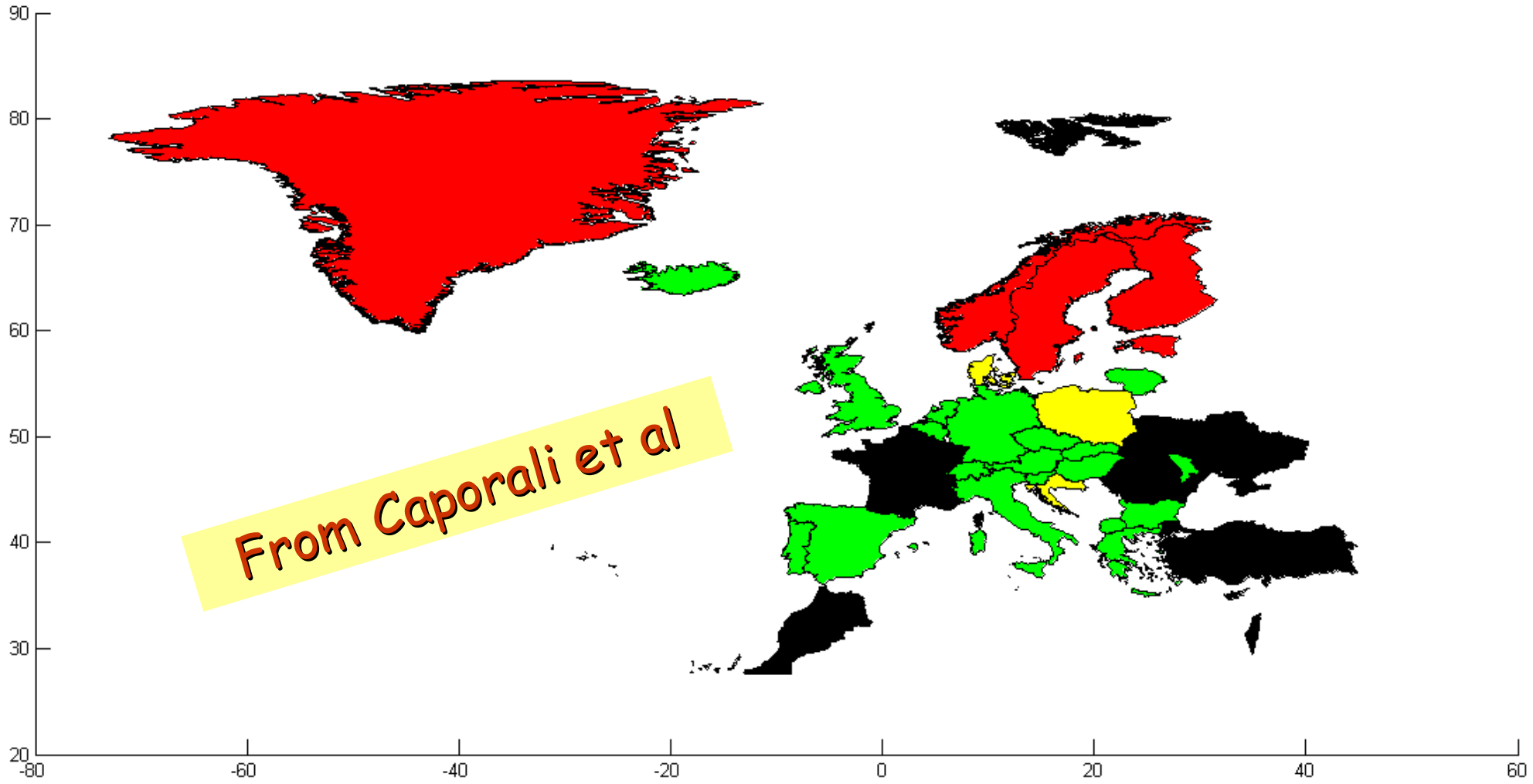
Predict when local vertical velocities generate discrepancy from frame > 3 cm



No realization | <2012 | >2012 <2020 | >2020

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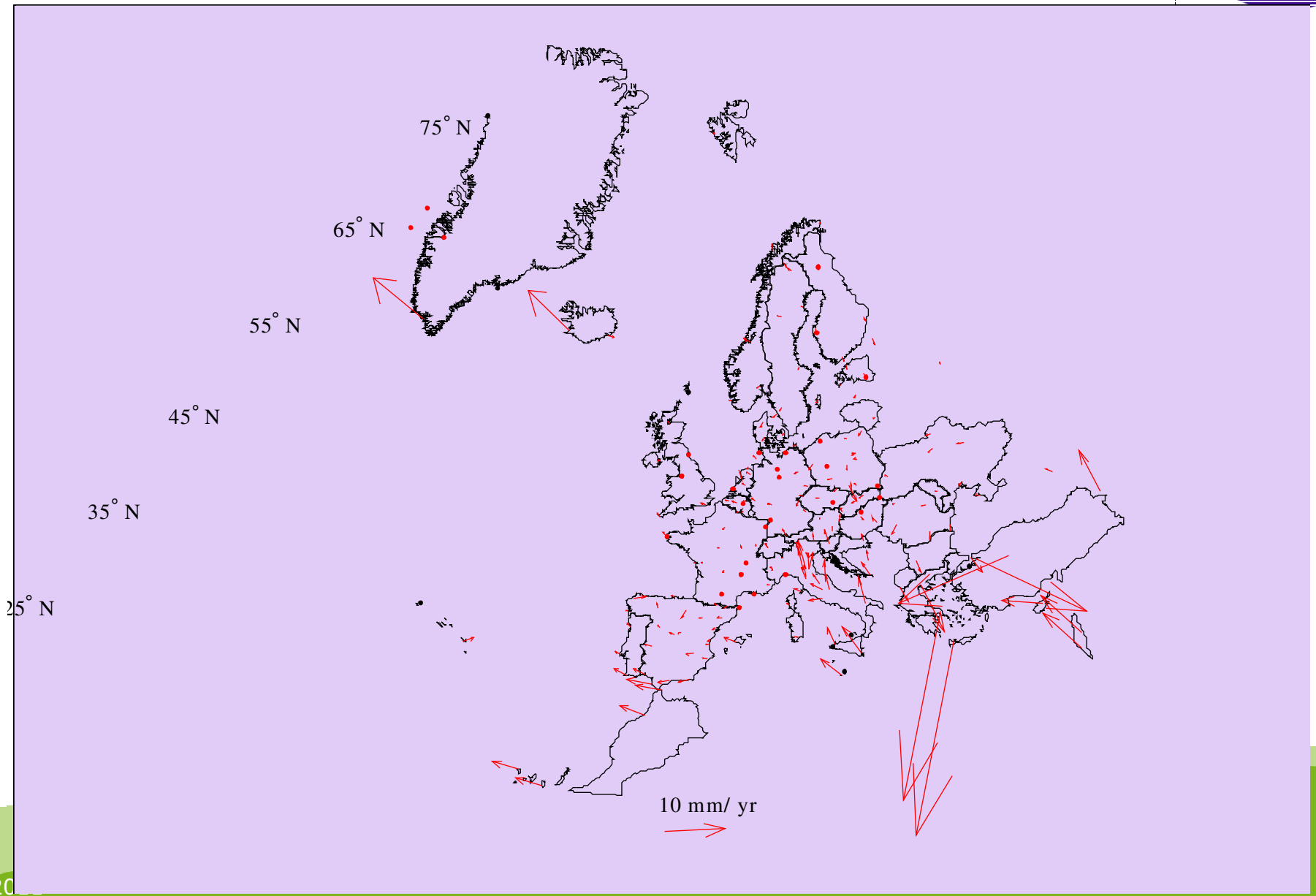
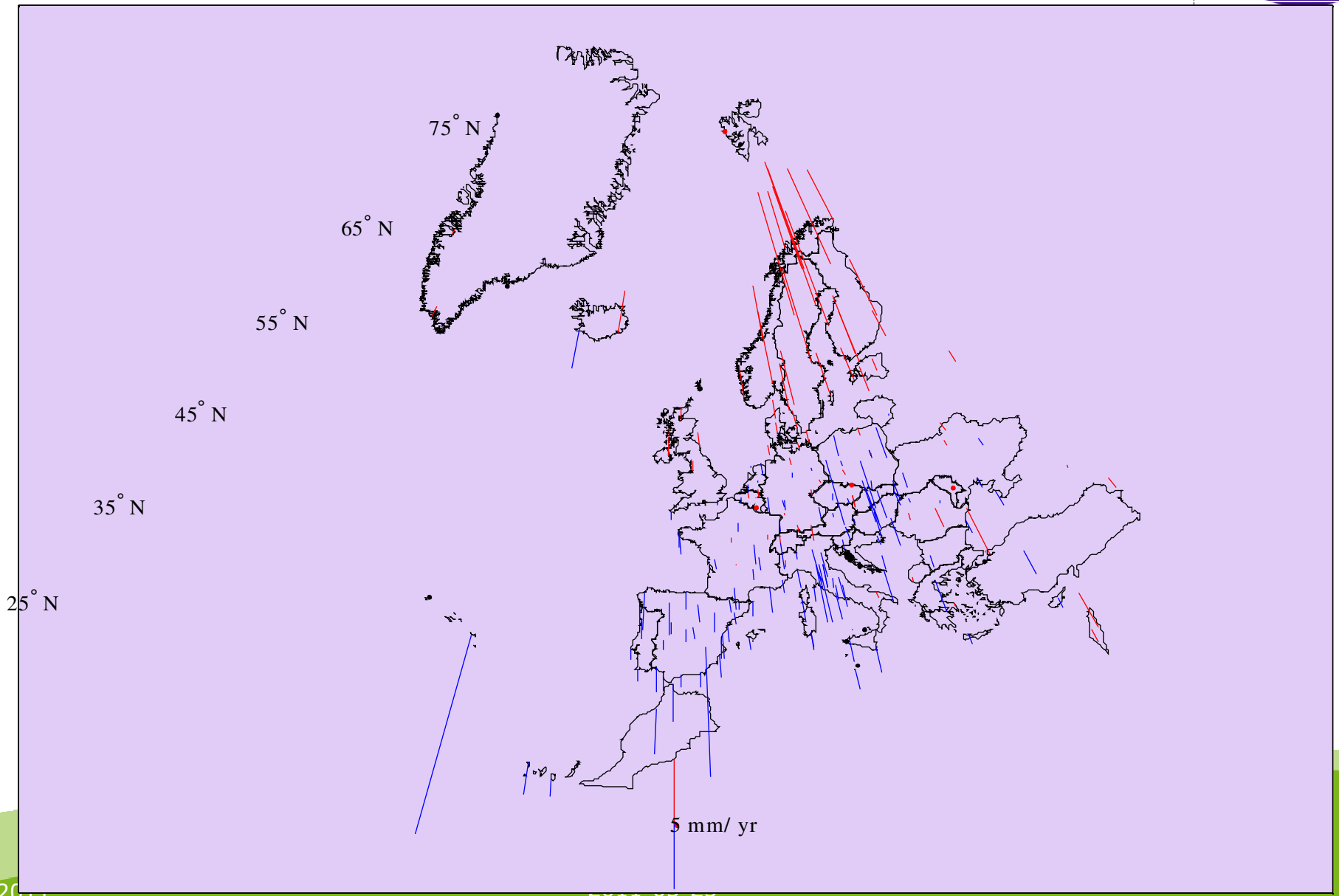
Horizontal velocities of class A sites

EPN cumulative solution EPN_A_ETRF2000_C1600



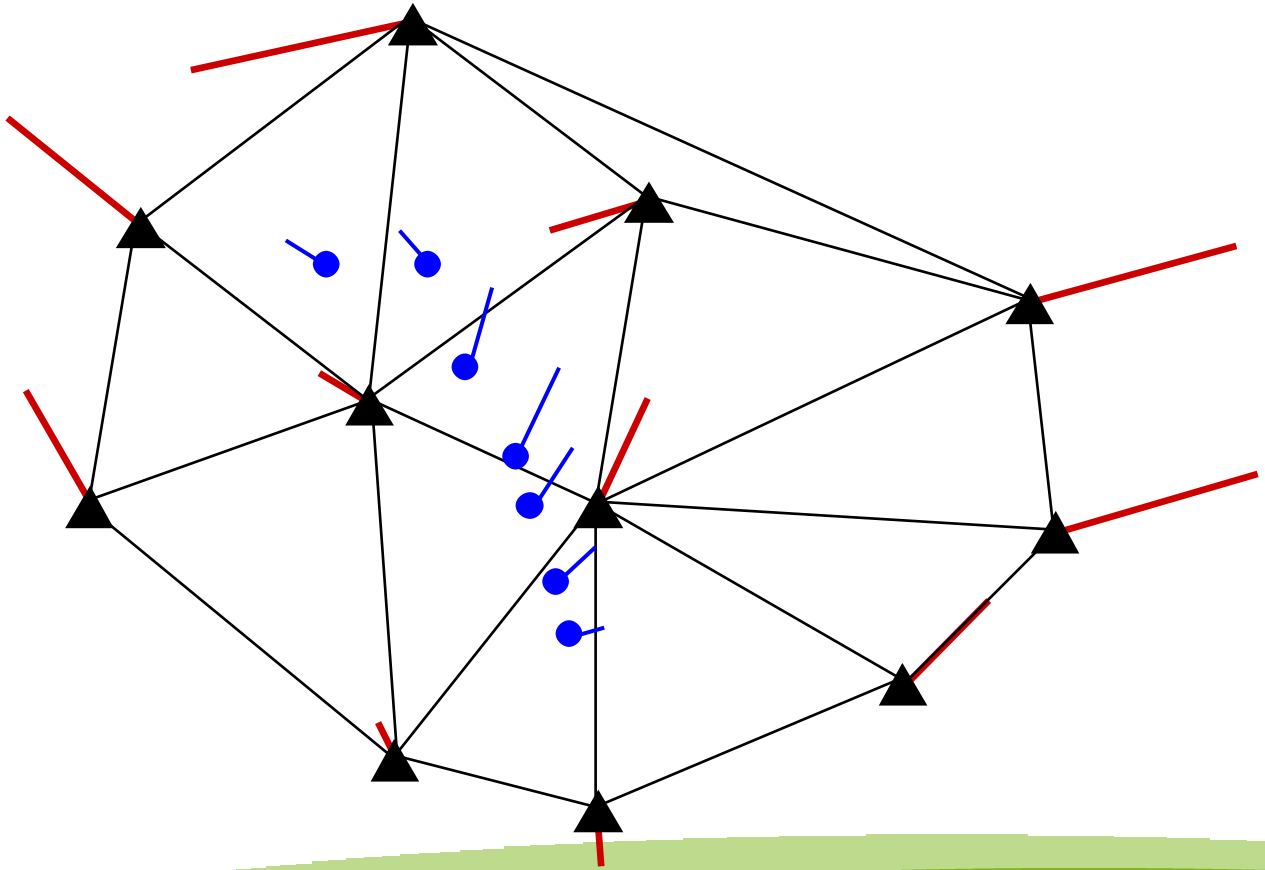
Vertical velocities of class A sites

EPN cumulative solution EPN_A_ETRF2000_C1600



Interpolation of Residuals

Principle: A residual at one point is valid for its surrounding area, and residuals at adjacent points are “similar”.



- Is this the situation? How can we test that?

Analysing the Variation of Deformations

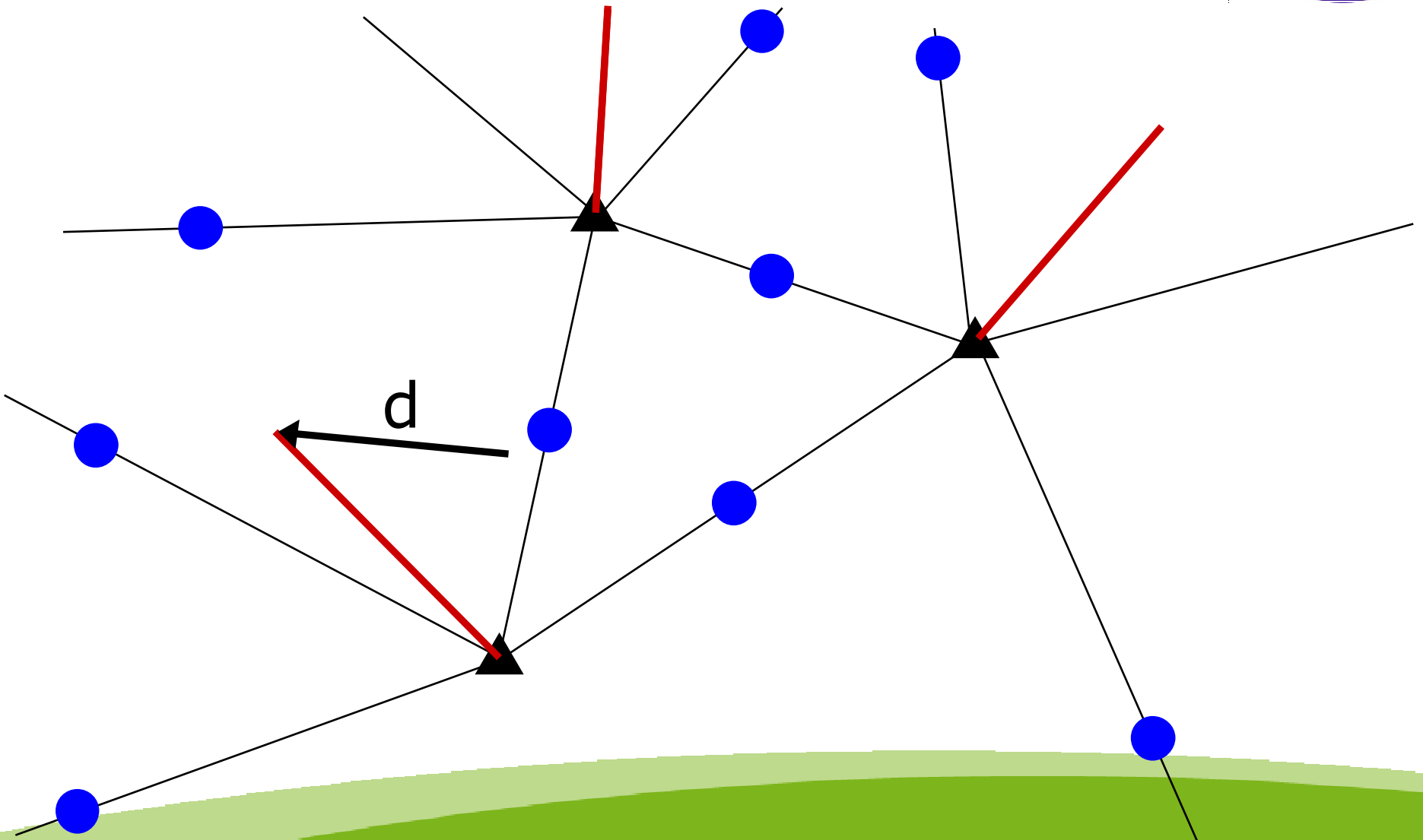


Image of the differential residuals in horisontal component

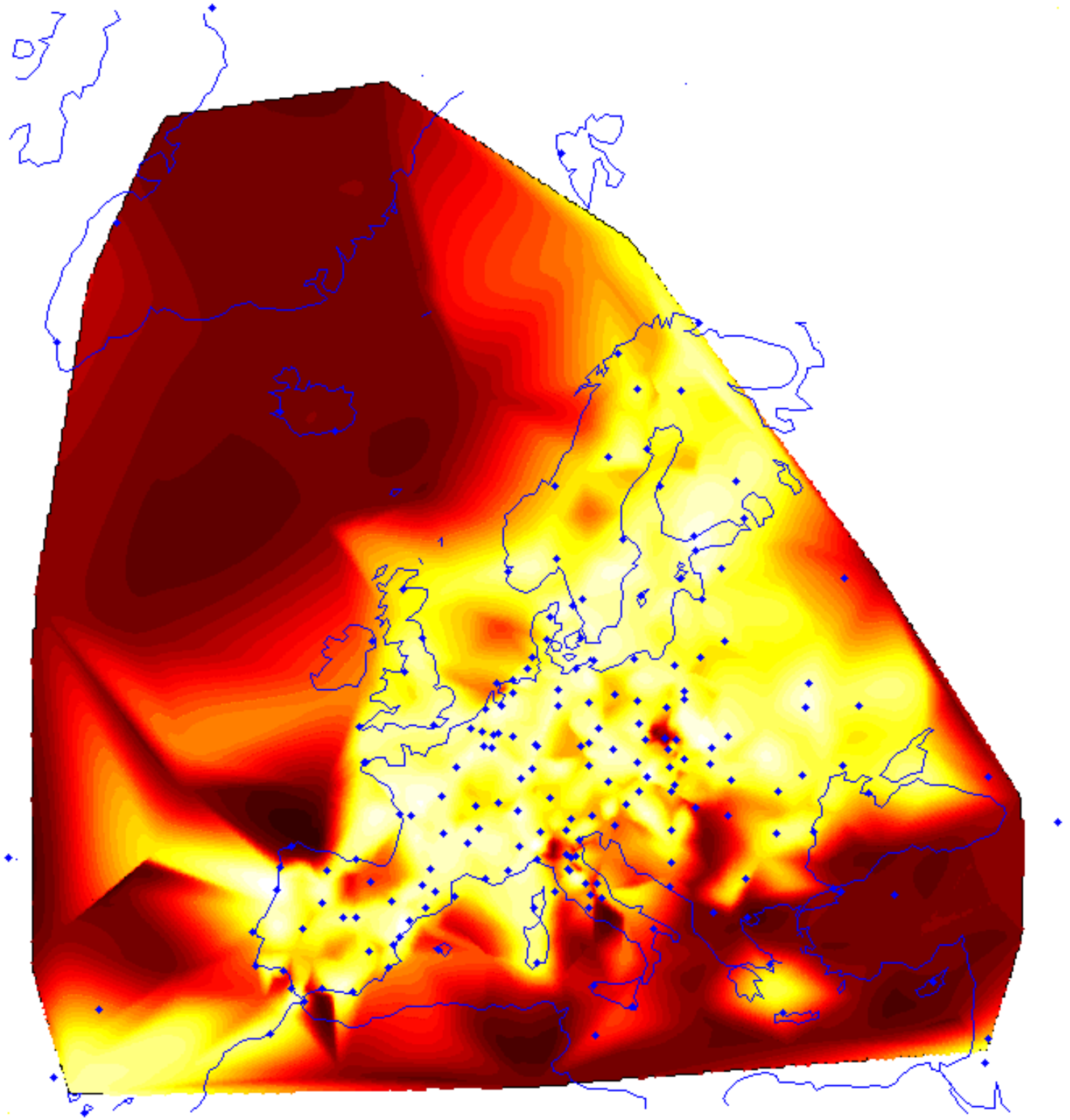
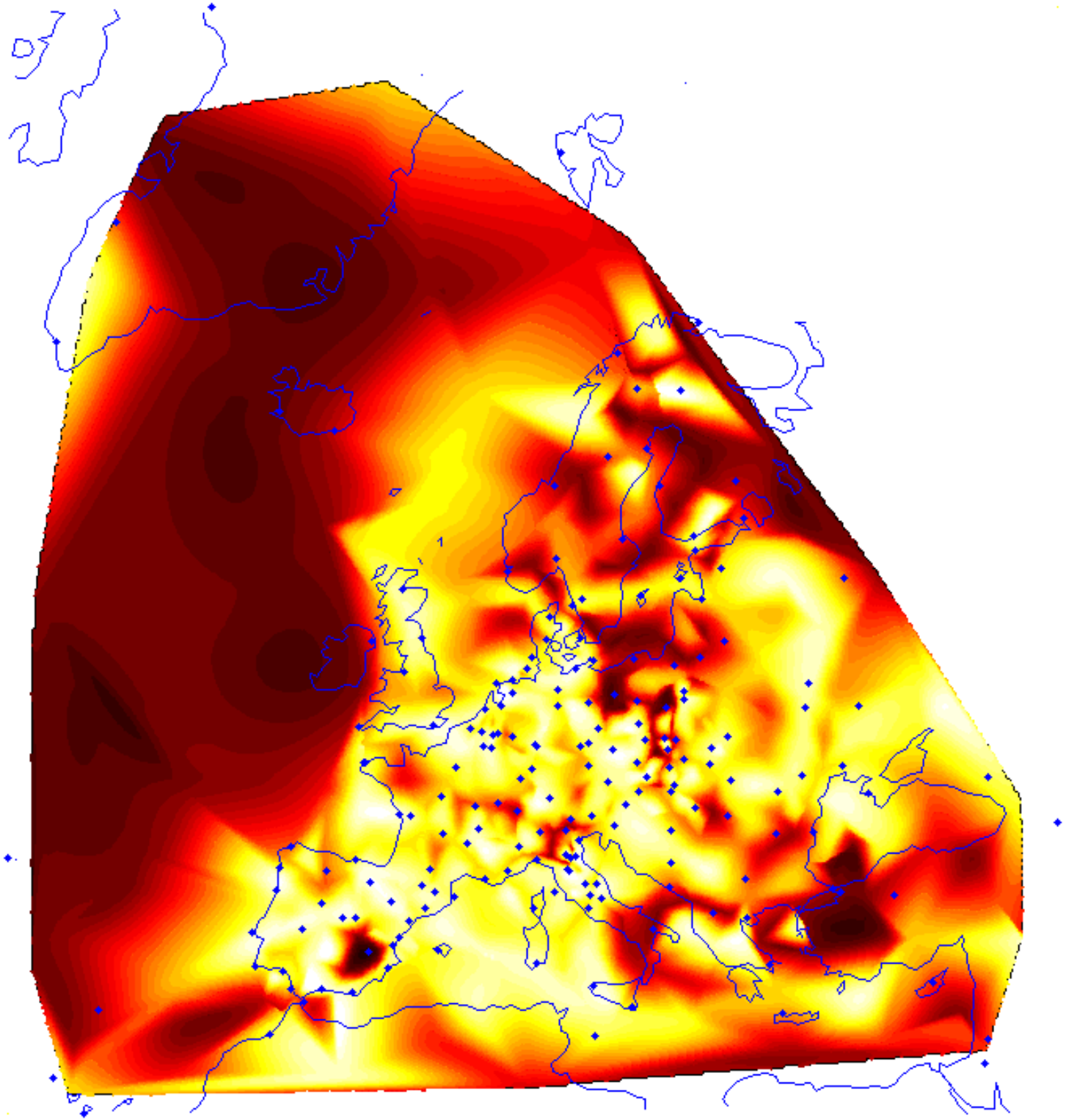
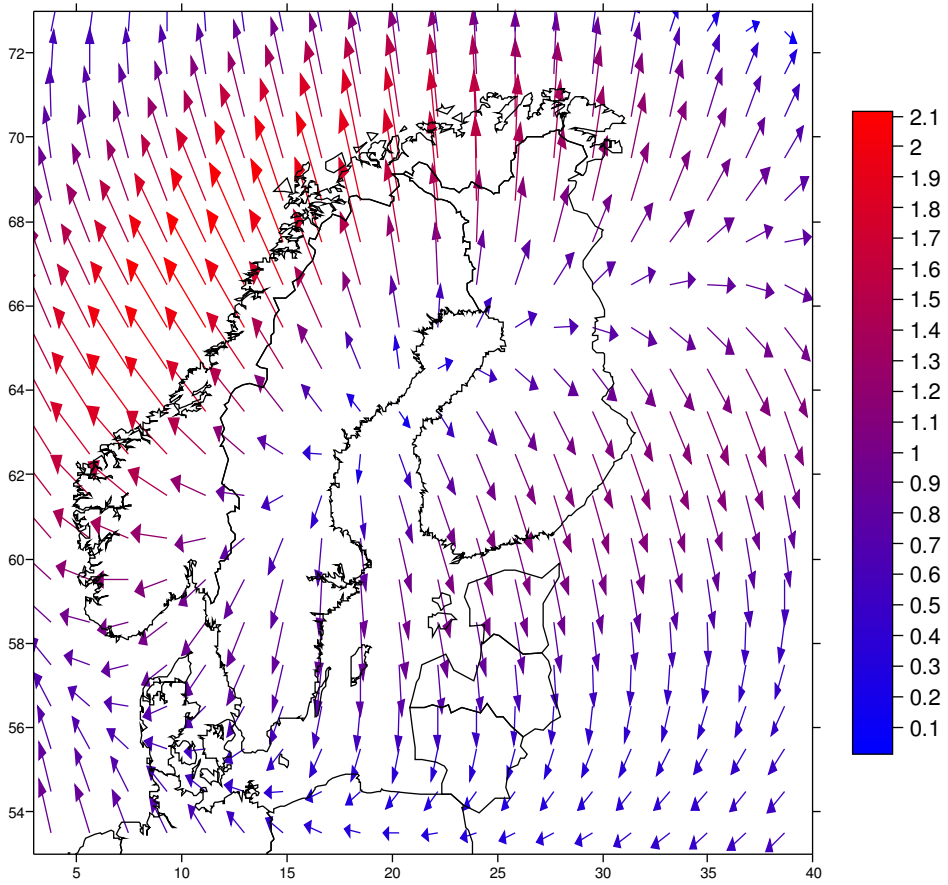


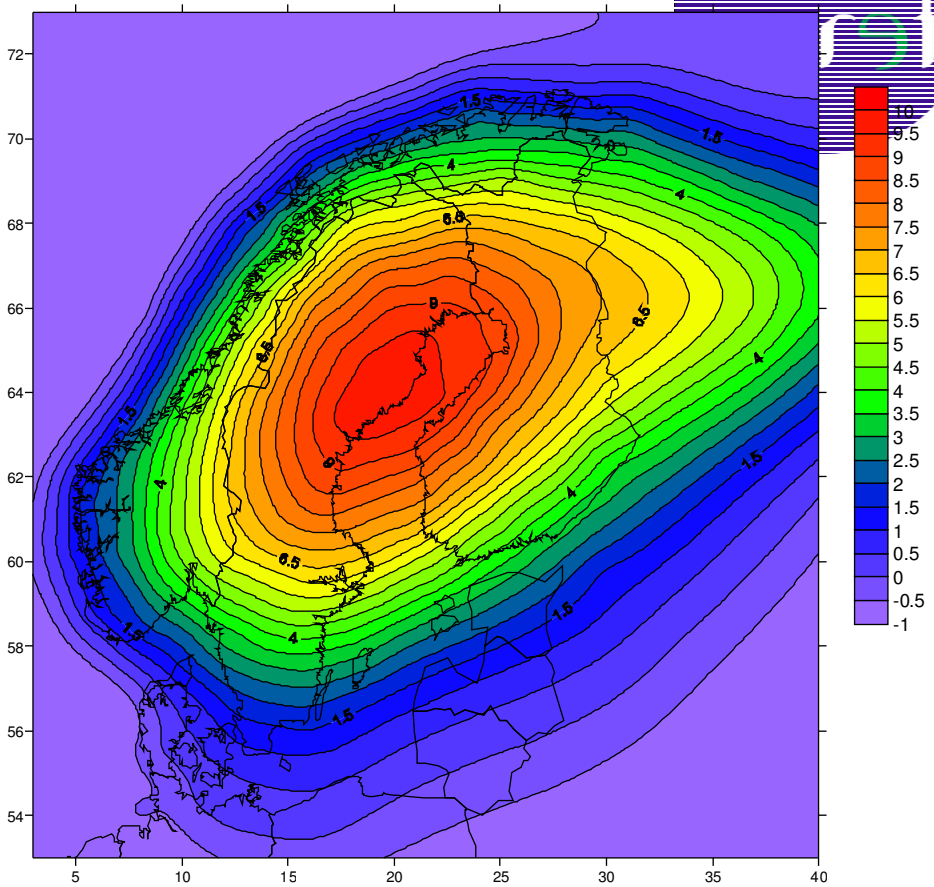
Image of the differential residuals in vertical component



The NKG_RF2003_vel velocity model



Horizontal (0 to 2 mm/yr):
The GIA model transformed to the GPS-velocities.



Vertical (-1 to 10 mm/yr):
The NKG2005LU(ABS) model
Based on: TG, repeated levelling, and GPS +GIA model.

Image of the differential residuals in horisontal component

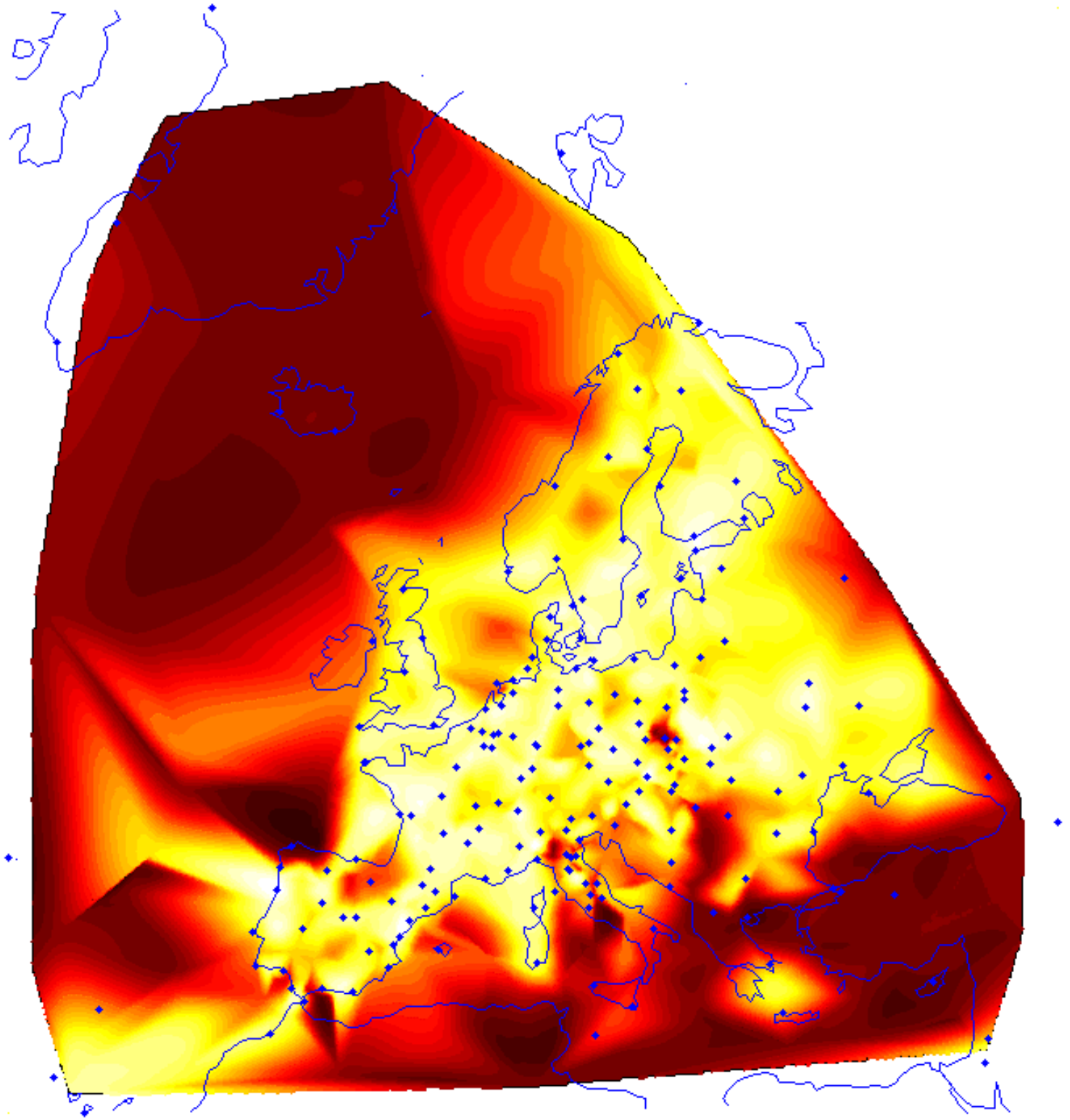


Image of the differential residuals in horisontal component corrected for PGR using the model

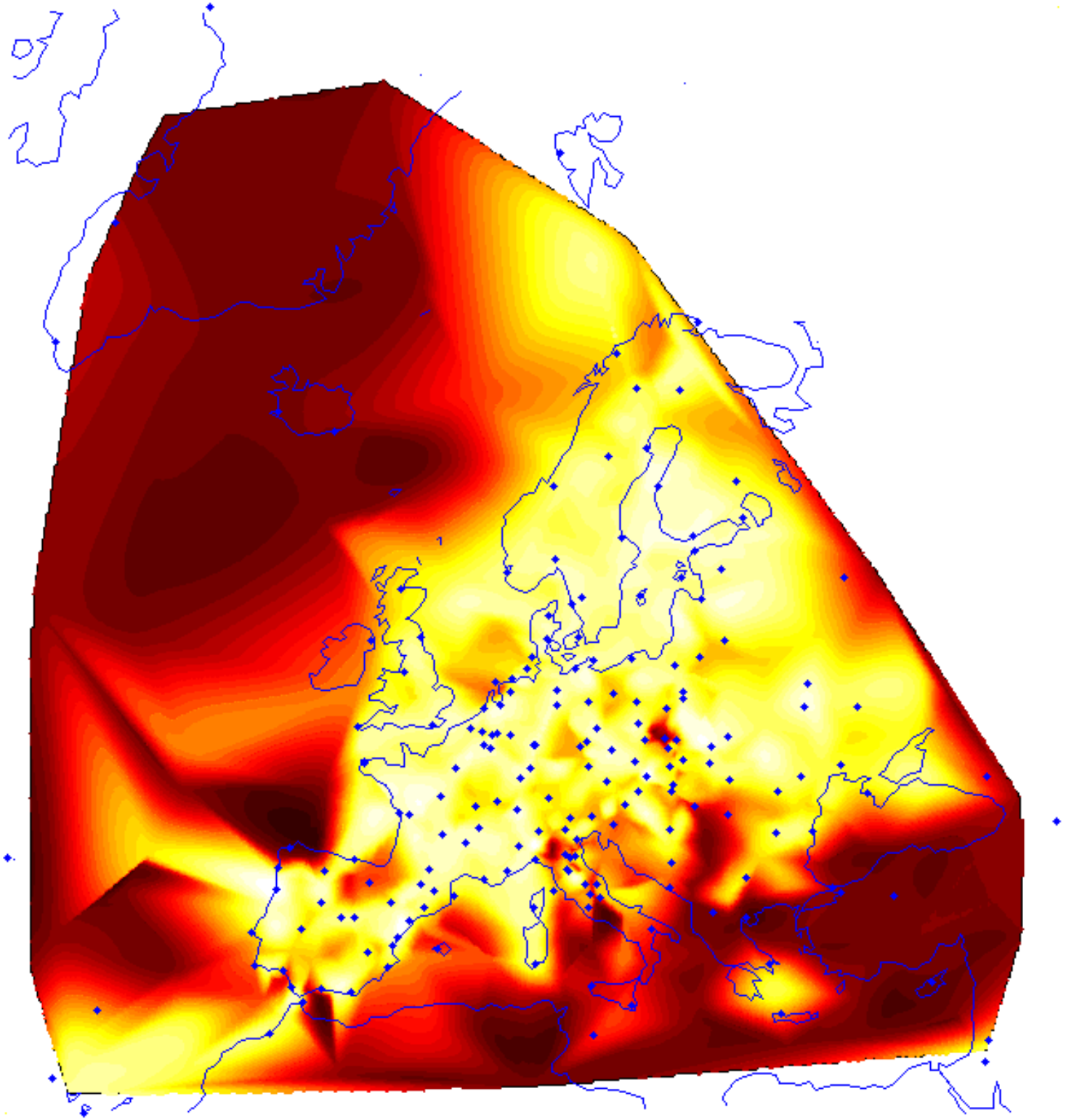


Image of the differential residuals in vertical component

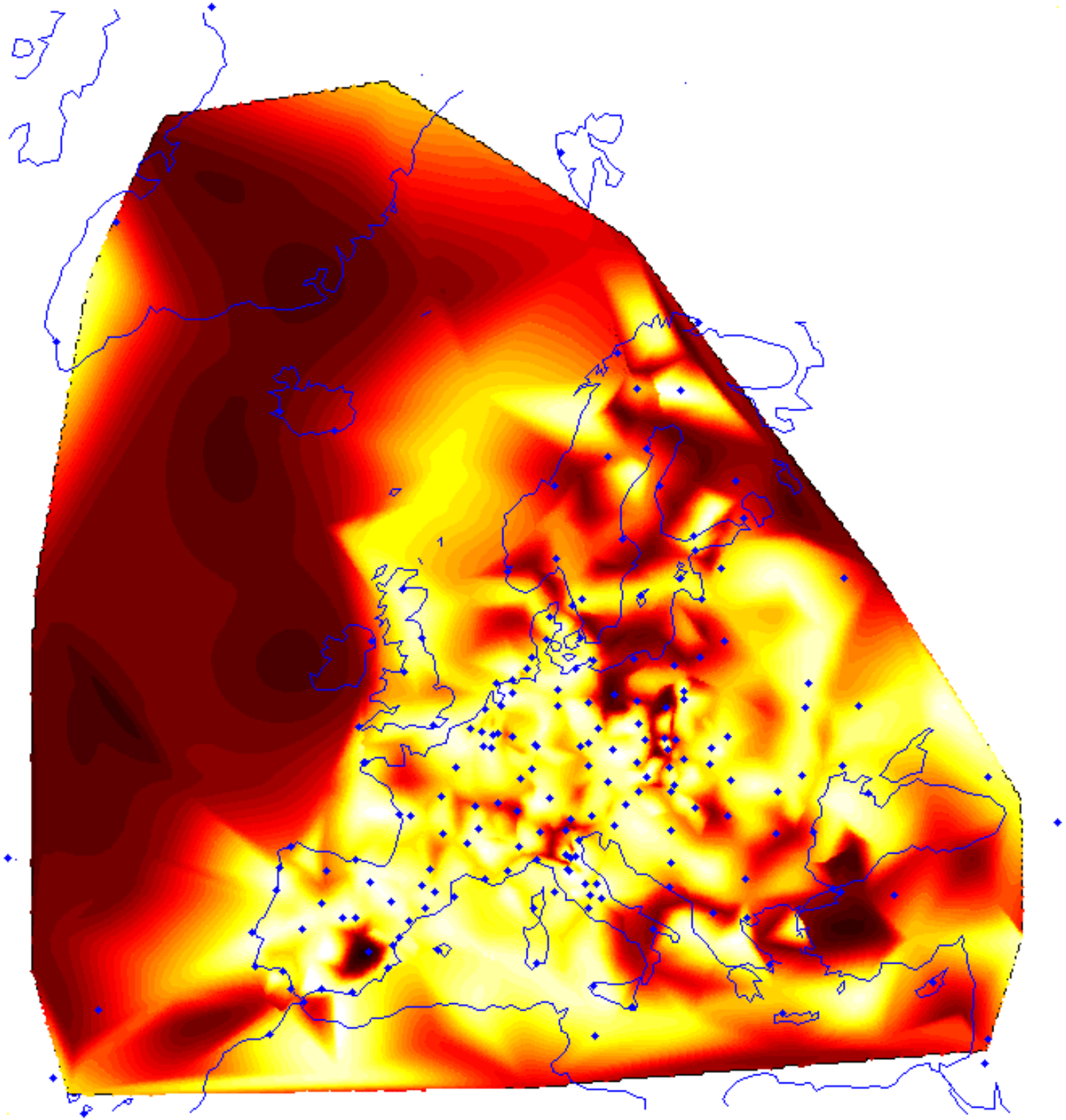
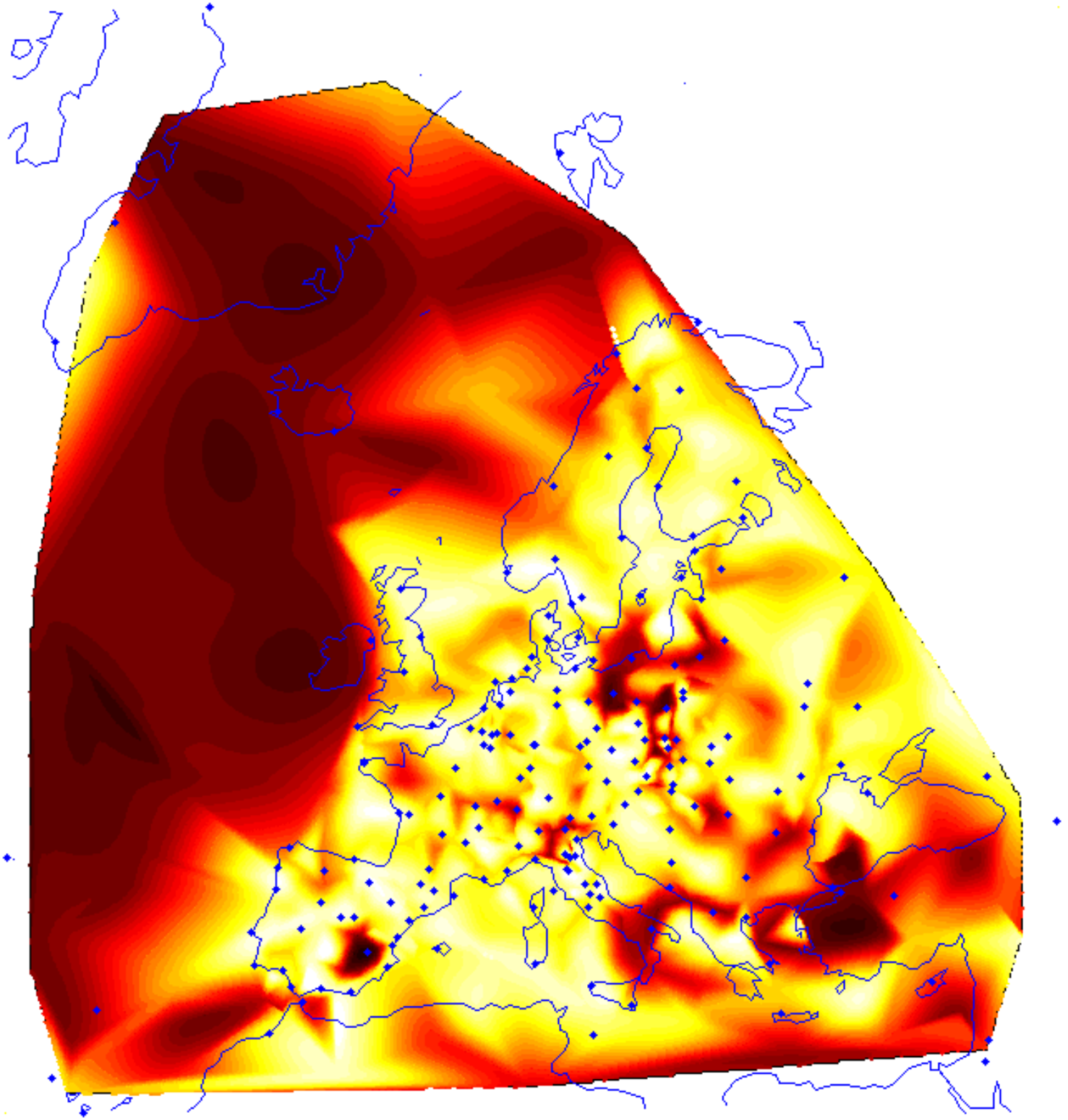


Image of the differential residuals in vertical component corrected for PGR using the model



Some conclusions

- The EPN alone are not enough to get the complete picture of crustal deformations within the geographical scope of EUREF
- Models (preferably geophysical meaningful) can be useful to improve the knowledge
- The EPN re-processing project will improve the estimated station velocities considerable
- … but also the spatial sampling must be improved by including additional permanent GNSS sites (e.g. a selection of the "RTK service stations")
- That would potentially form the basis for realistic models of the crustal deformations.

EUREF Permanent Tracking Network