

Analysis of the Czech magnetic anomaly data obtained by ground-based and airborne magnetic surveys

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Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání



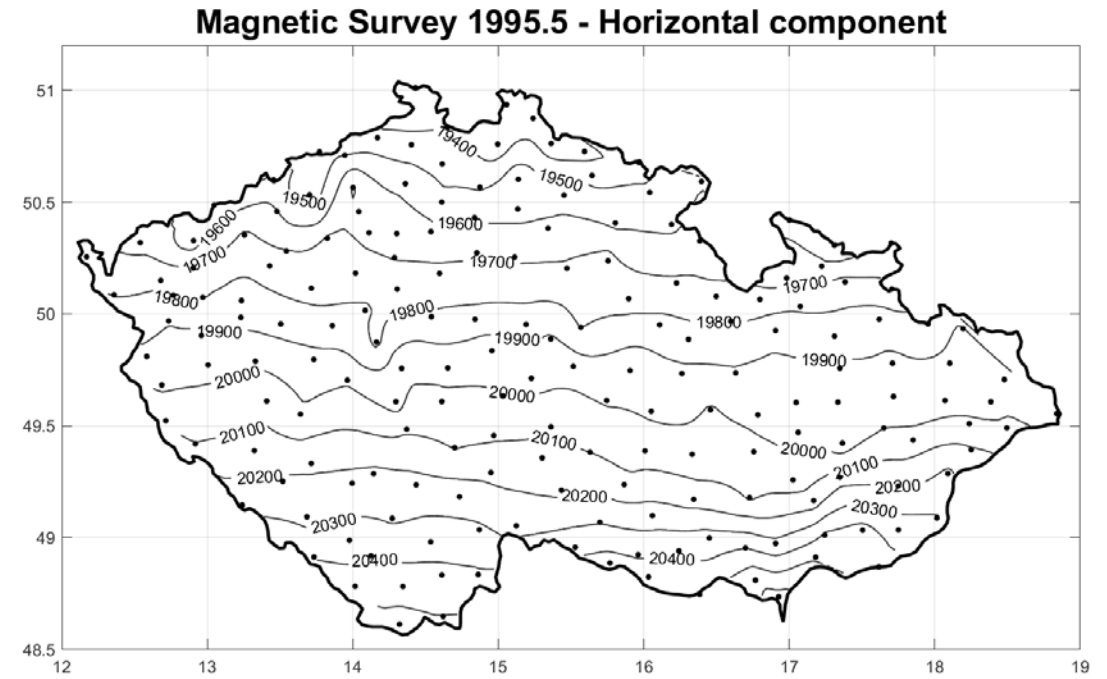
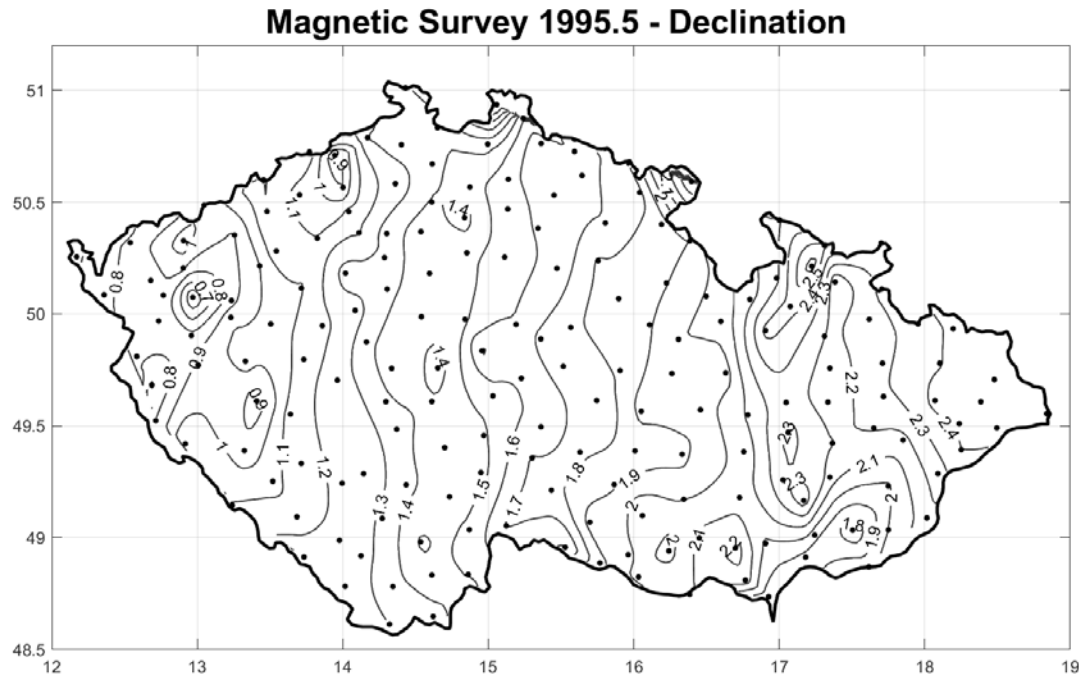
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Ground- based magnetic survey

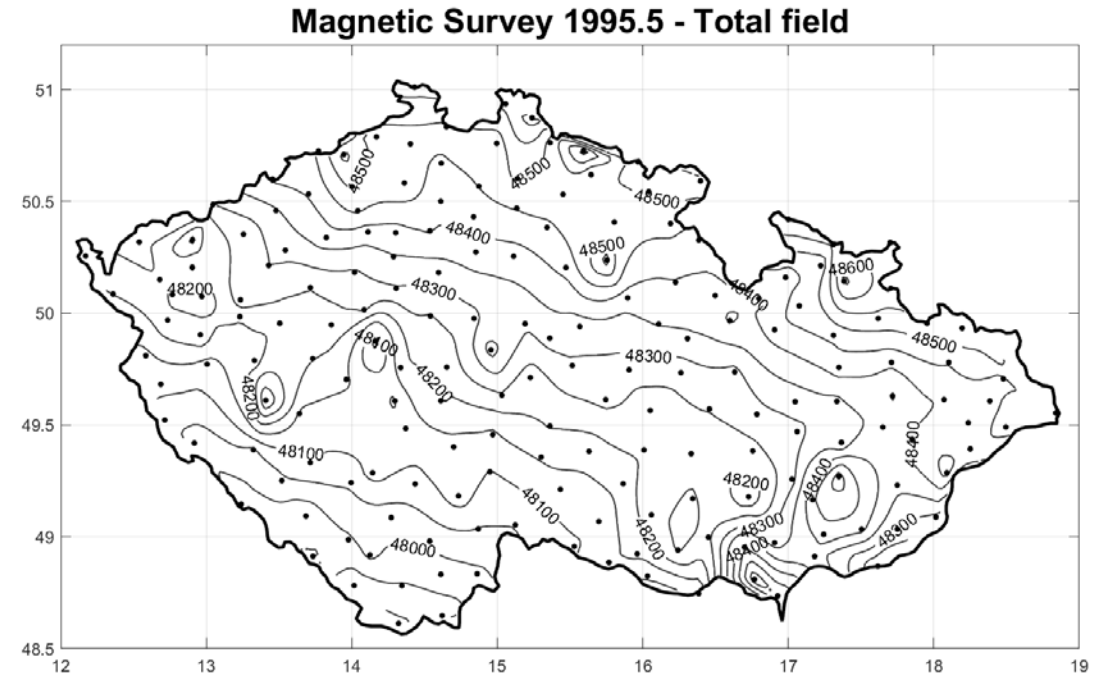
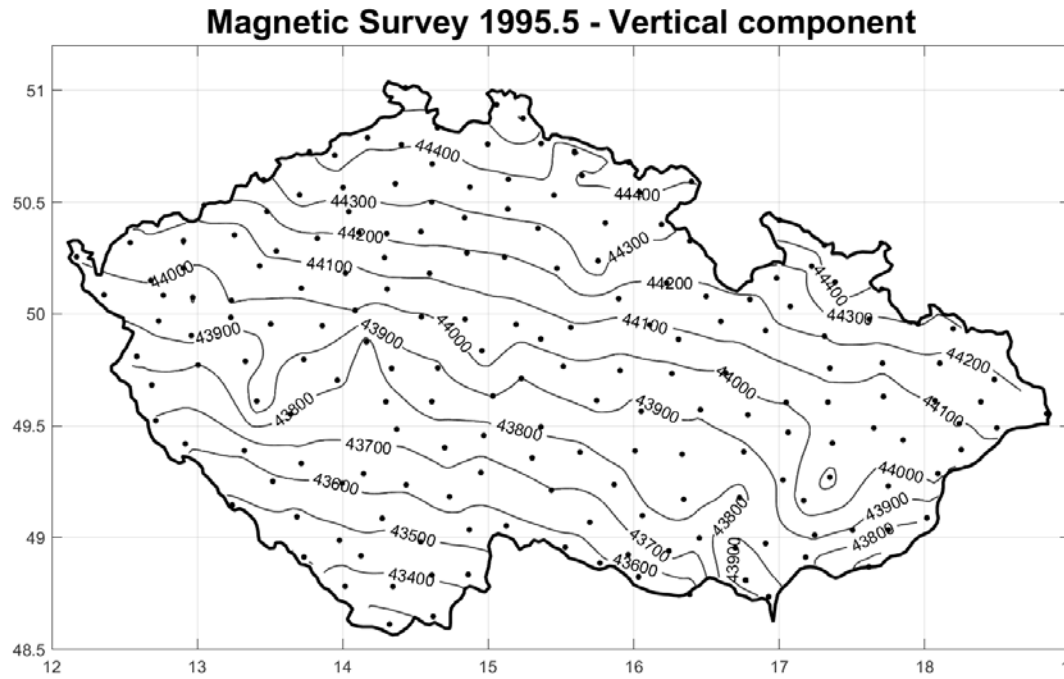
- The recent epoch of the magnetic surveying activity started in the 1950th by setting up a fundamental network of the first order.
- It consisted of 199 points stabilized by granite boundary-stones.
- Measurements of the vertical and horizontal components were carried out in 1957-58.
- The network was reoccupied in 1976-78 when the measurements of the three components D (by Matting & Wiesenbergs theodolite), H (QHM) and Z (BMZ) were completed by the measurements of the total field T (by PPM).
- The last magnetic survey was carried out in 1994-96 by a fluxgate theodolite for measurements of declination and inclination and by a proton precession magnetometer for the total intensity. The data were reduced to the epoch 1995.5.
- Due to the building activities and corresponding magnetic noise, several points were lost and some other had to be slightly shifted or moved to another place – several hundred meters to several kilometres away. The total number of points was reduced to 192.

Ground Magnetic Survey 1994–1996



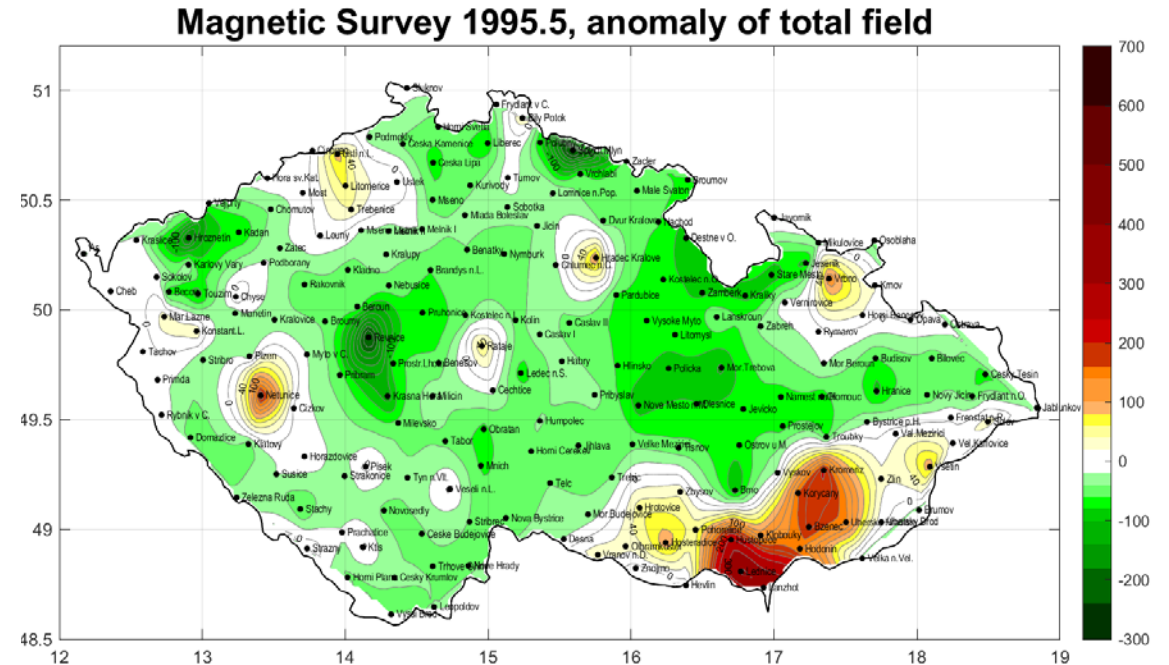
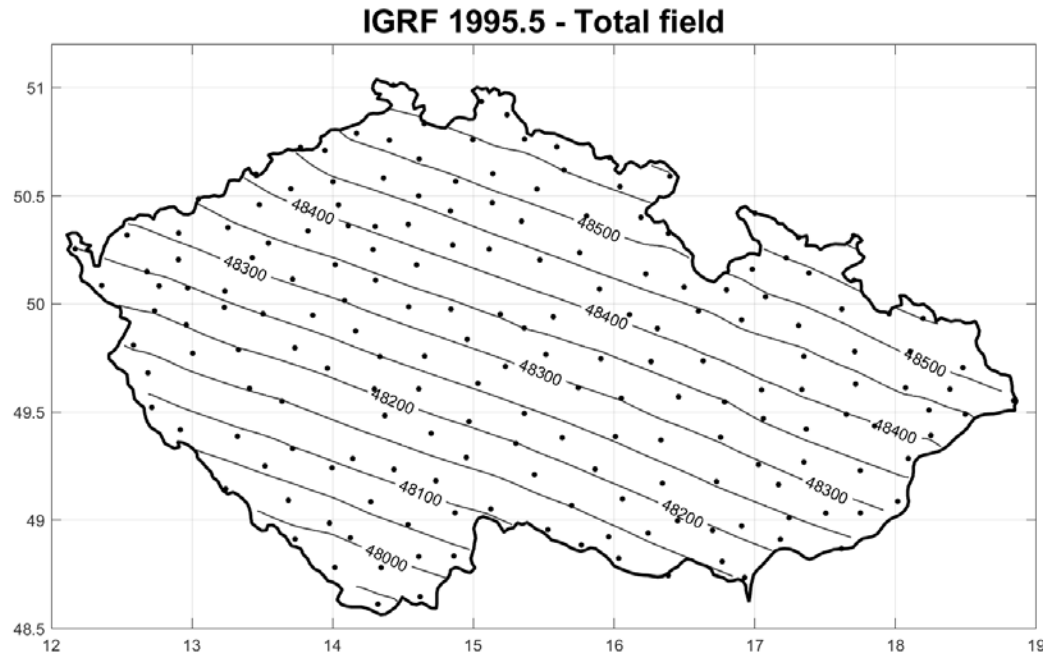
192 points corresponds to 1 point per 400 sq. km or to the mean distance between points 20 km. This magnetic survey is thus suitable for study of regional irregularities/anomalies that have their origin in larger deeper structures and their interactions with quite complicated structure of the geomagnetic field generated in the Earth's core.

Ground Magnetic Survey 1994–1996



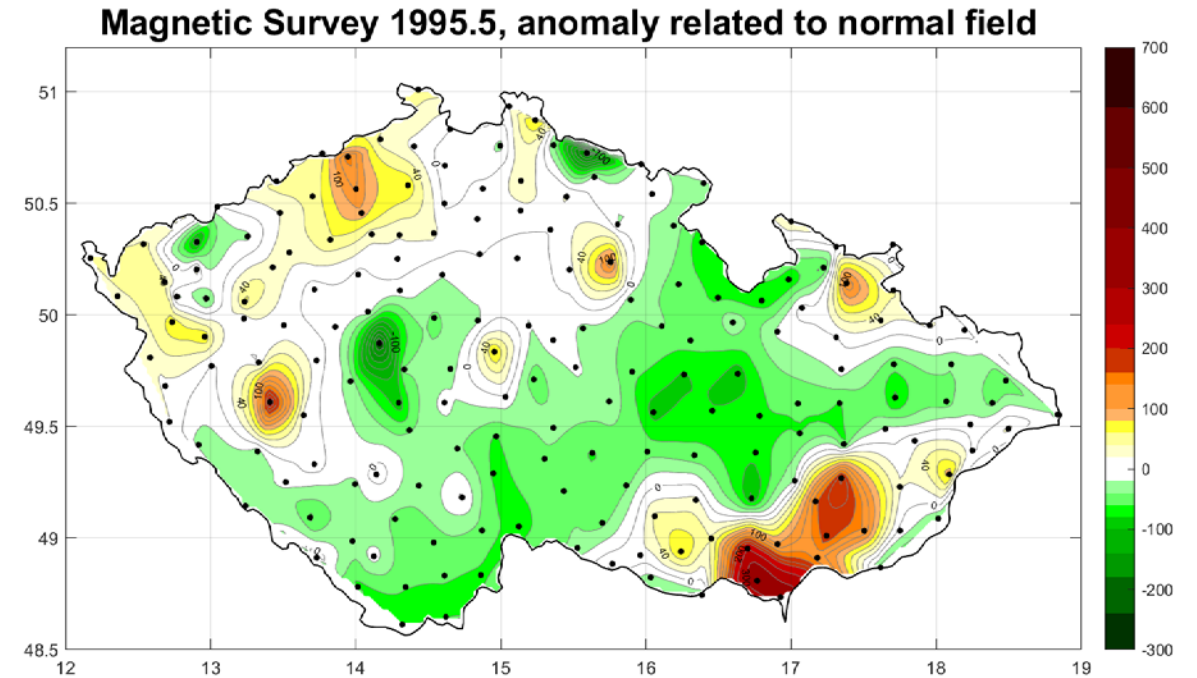
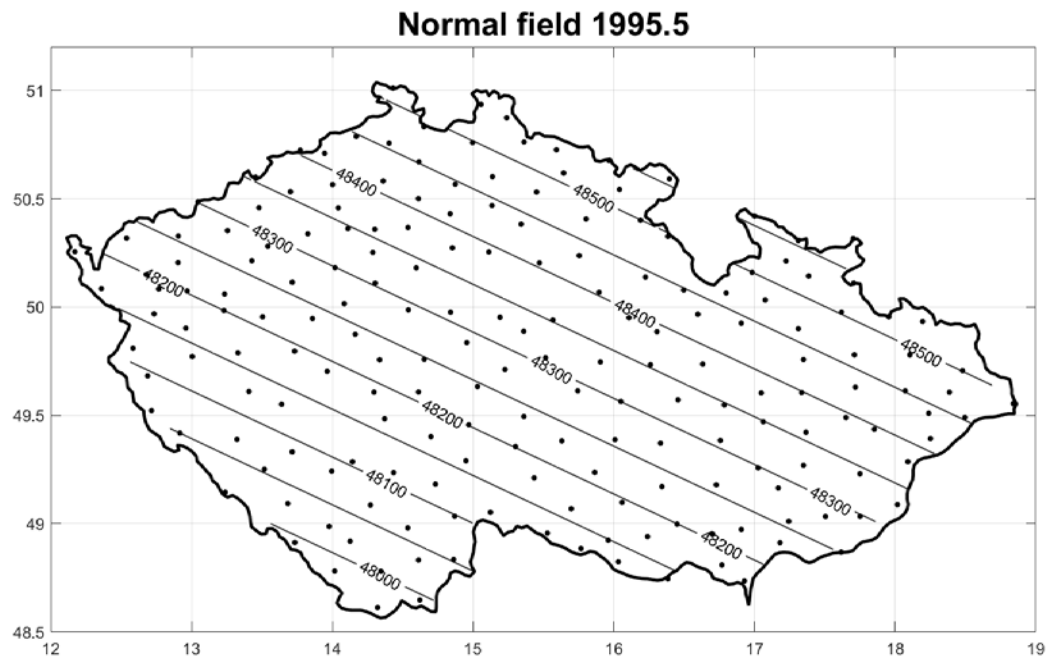
The selection of the measuring points in 1950th was an uneasy task. The geomagnetism team tried to find quiet sites far from urban and industrial magnetic noise. They carried out measurements in the neighbourhood to avoid local disturbance and avoided also well known magnetically disturbed areas like Doupovské hory Mts. or Central Bohemian Anomaly. However, they were not able to guarantee that the site is representative for the region.

Ground Magnetic Survey 1994–1996 and magnetic anomalies



The anomaly magnetic field can be obtained either by subtraction of global models, like International Geomagnetic Reference field – IGRF, or of local normal field. The advantage of global models consists in their regular update, on the other hand, there can be a shift of tens to first hundreds of nT. On our territory the model fits quite well.

Ground Magnetic Survey 1994–1996 and magnetic anomalies



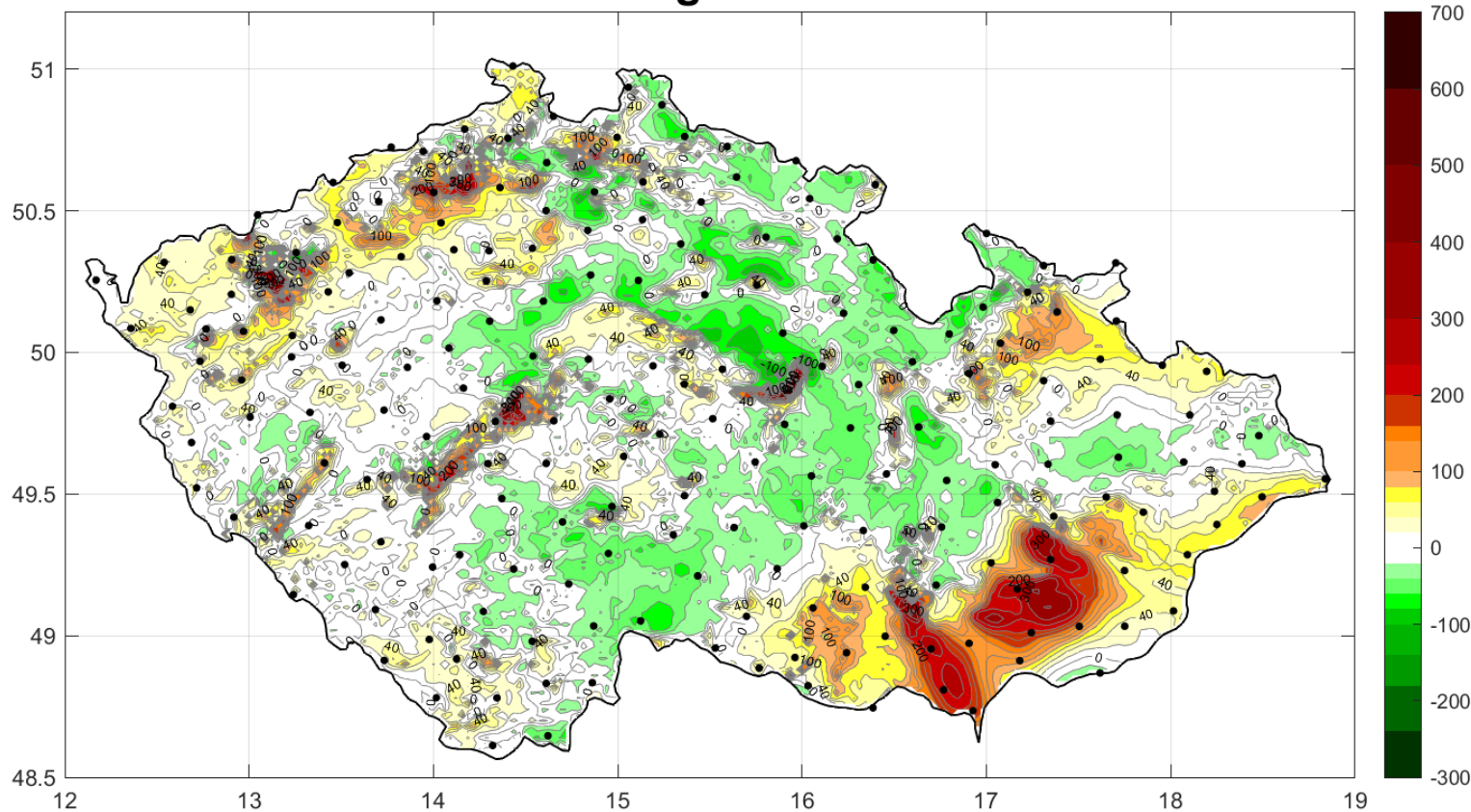
The normal field was computed by linear regression from all measured points. There is thus a better balance between negative and positive values. The IGRF values are higher of up to 50 nT. The normal field can be upgraded to another epoch by means of repeat station (secular) points that are occupied bi-annually.

Aeromagnetic survey

- Extensive aeromagnetic measurements have been performed from 1959 to 1972 by permalloy probe of Soviet provenience. The accuracy of the instrumentation was about (and often above) 10 nT.
- The second period of airborne survey started in 1976. Thanks to the deployment of proton precession magnetometer, the accuracy improved to ~ 2 nT.
- Since 2004 the measurements were carried out by caesium magnetometer. The data were digitized, known anthropogenic anomalies were cleared away and data were transformed to the regular grid with step 250 m. The anomaly field was computed by subtraction of IGRF.
- The final data file of magnetic anomalies ΔT , administered by the Czech Geological Survey, represents a substantial contribution to the exploration of ore deposits and to the structure geology in general.
- The recent study is based on data set reduced to 1km grid size.

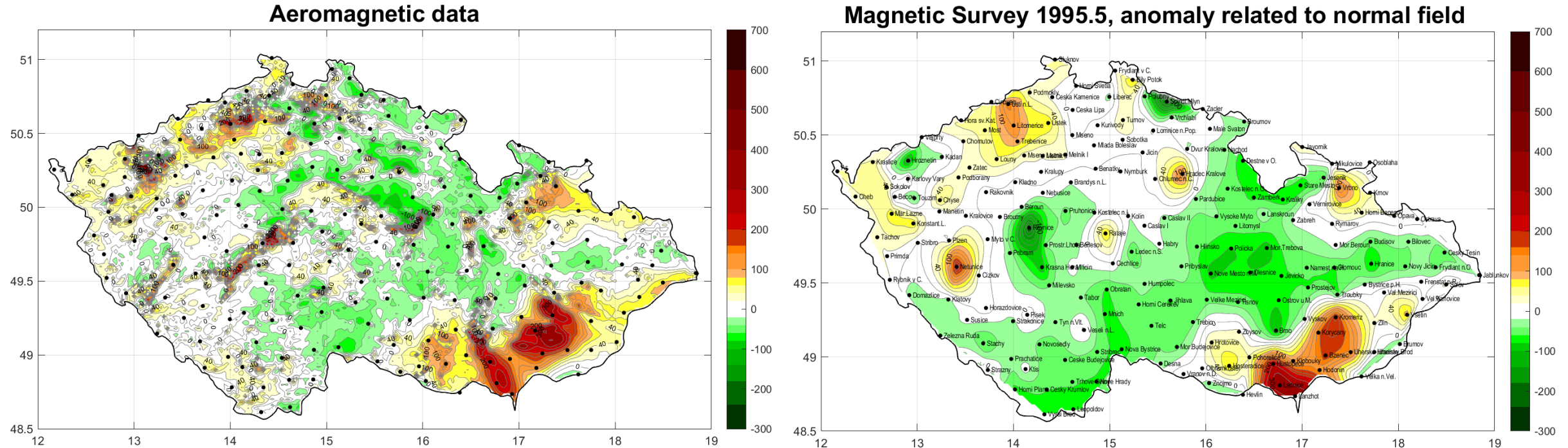
Aeromagnetic survey

Aeromagnetic data



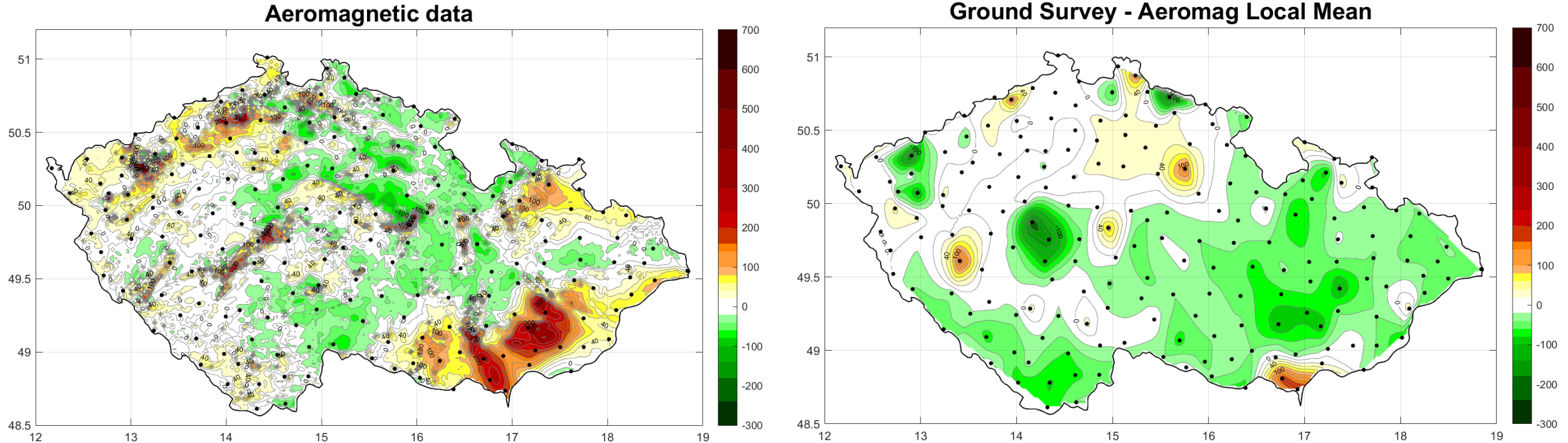
- Magnetic image of the CR is a result of the superposition of local and regional magnetic anomalies.
- The Moravian magnetic anomaly represents the largest structure.
- The Czech territory can be divided into two areas, disturbed positively or negatively.
- Typical features of positive magnetic anomaly regions are small thickness of crustal and granitic layers. Basic volcanism and plutonism are also more widespread.
- The negative magnetic areas are characterised by a great thickness of the crust, large granitic plutons and higher metamorphism.

Anomalies by aeromagnetic mapping and ground magnetic survey



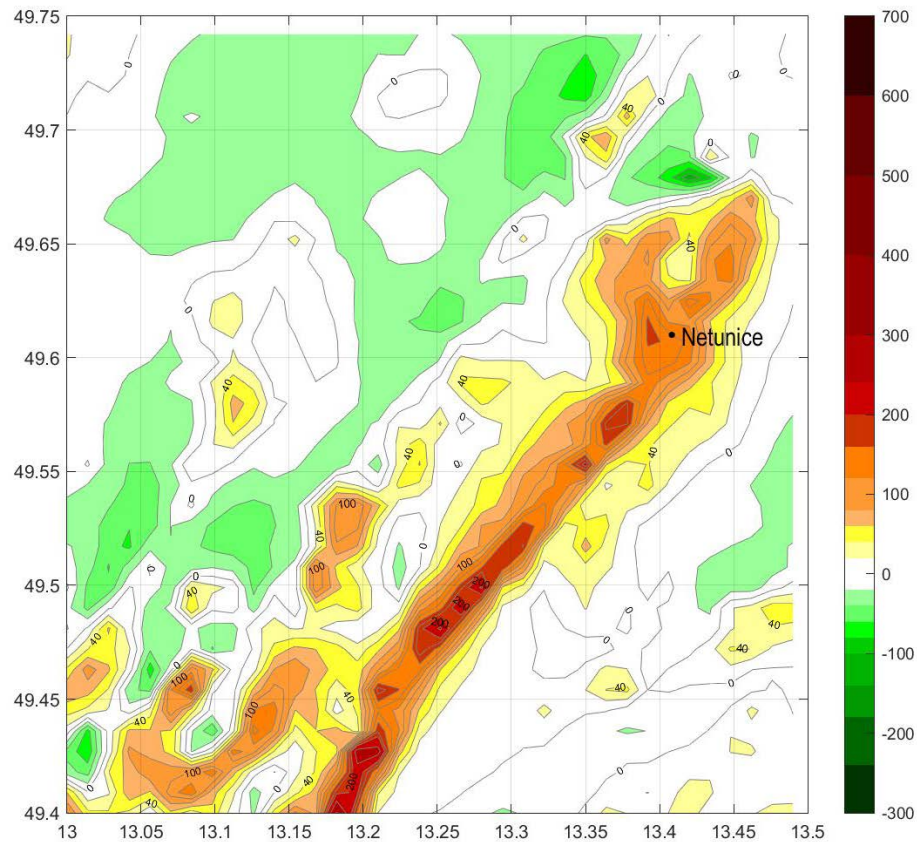
The anomaly map based on the ground magnetic survey data reflects the large scale magnetic anomalies in South-East and North Moravia as well as in North-West Bohemia. Small scale structures cannot be fitted in a map based on 1 site per 400 sq km. On the contrary, it can happen that local anomaly will be magnified/extended in the contouring.

Difference between ground survey and local aeromagnetic field

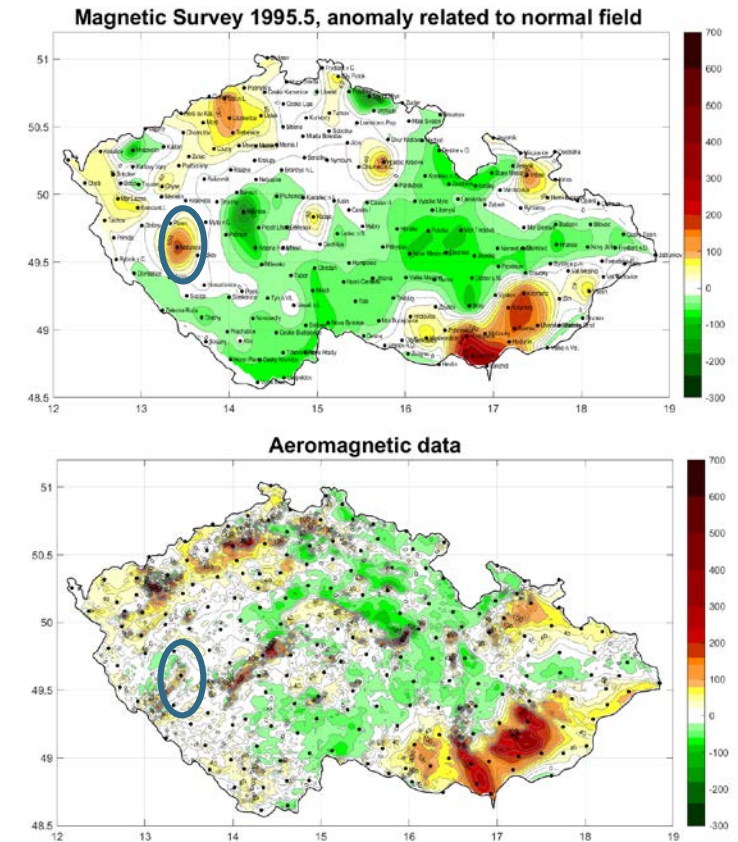


Mean local field was computed from aeromagnetic data in perimeter of 6 km for all points of the fundamental network. The right figure shows difference between values obtained at these points and mean local field. High positive or negative value indicate that the point is not representative for its neighbourhood. Several cases will be analysed on next slides.

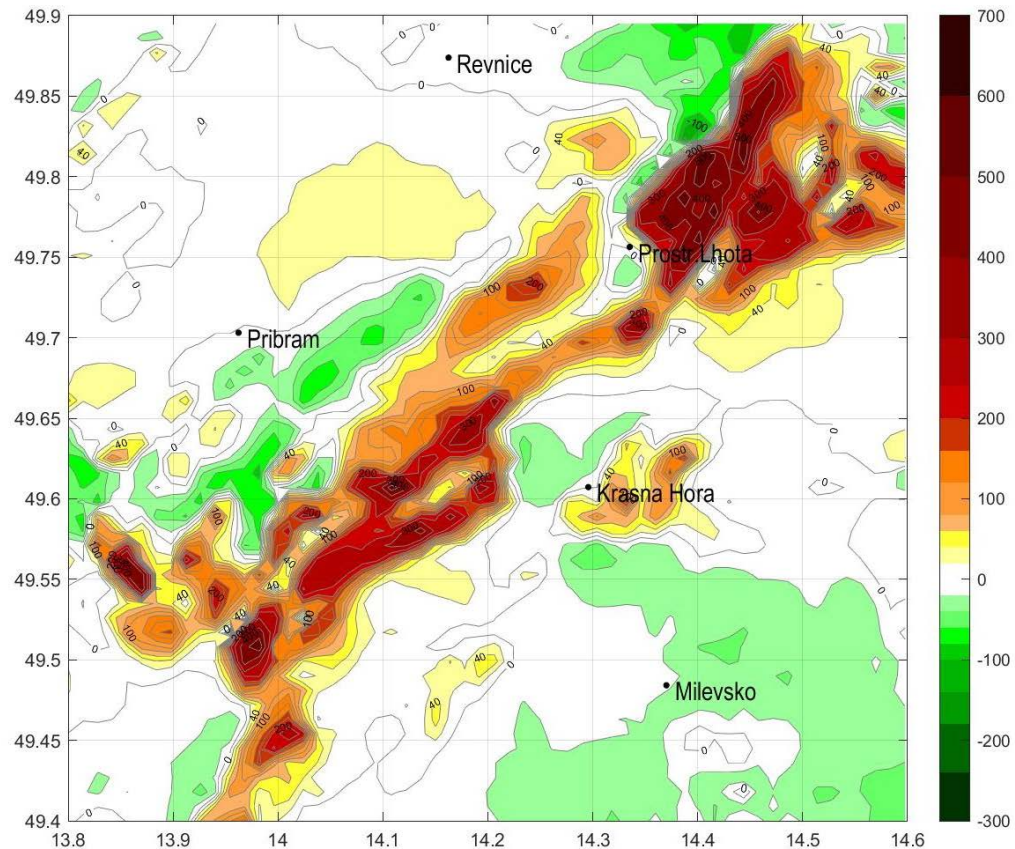
Intricate region: Netunice



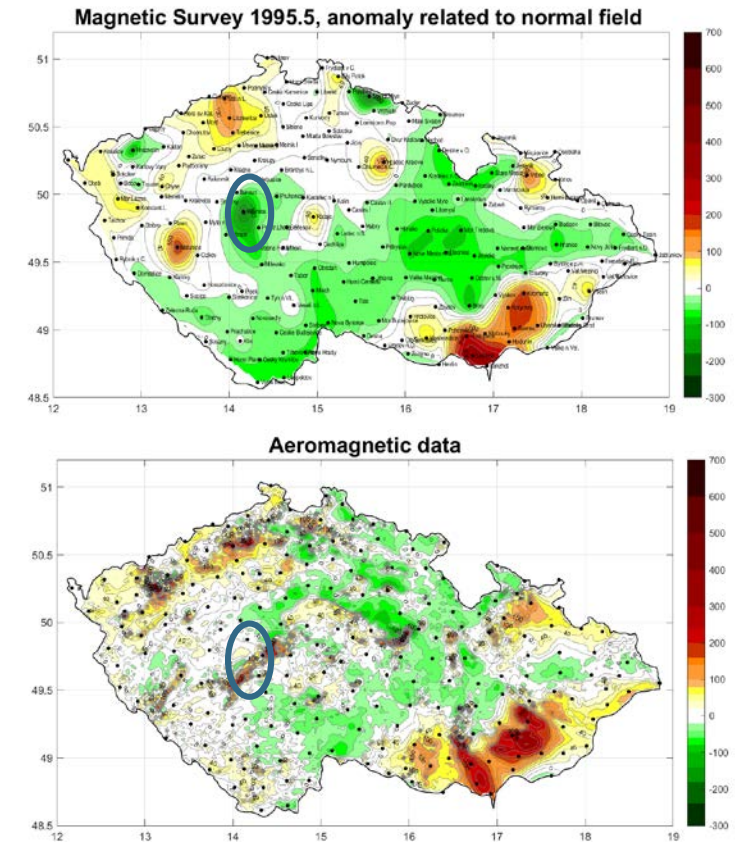
The point is situated on the very edge of an elongated magnetic anomaly with a typical width 5 km. The large magnetic anomaly caused by this point is artificial. The point will be removed from the data for map construction.



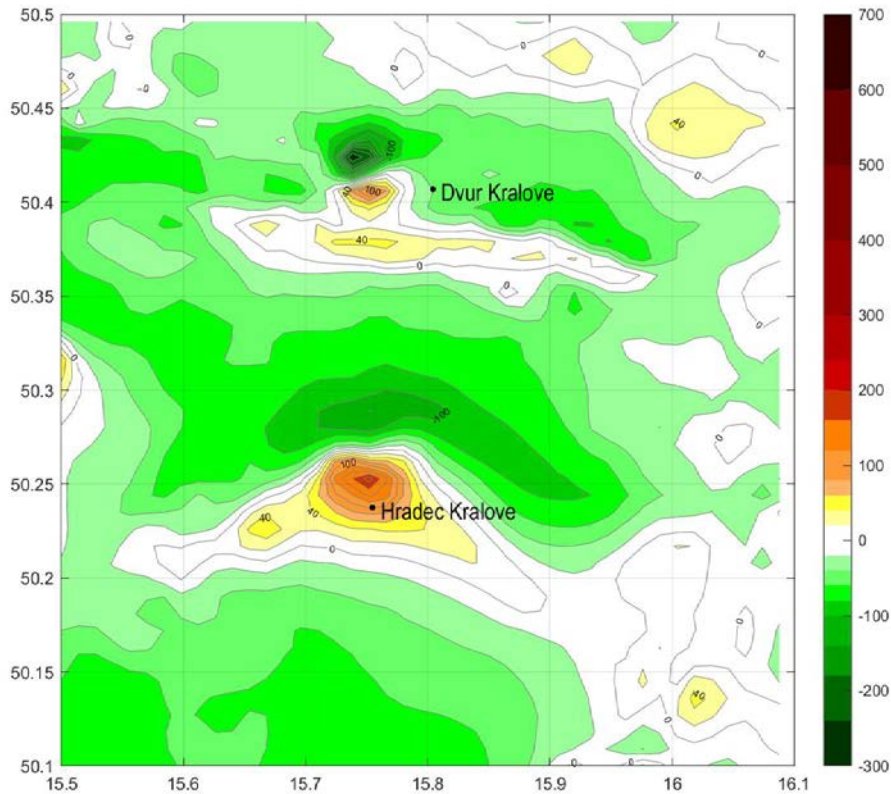
Intricate region: Central Bohemian Anomaly



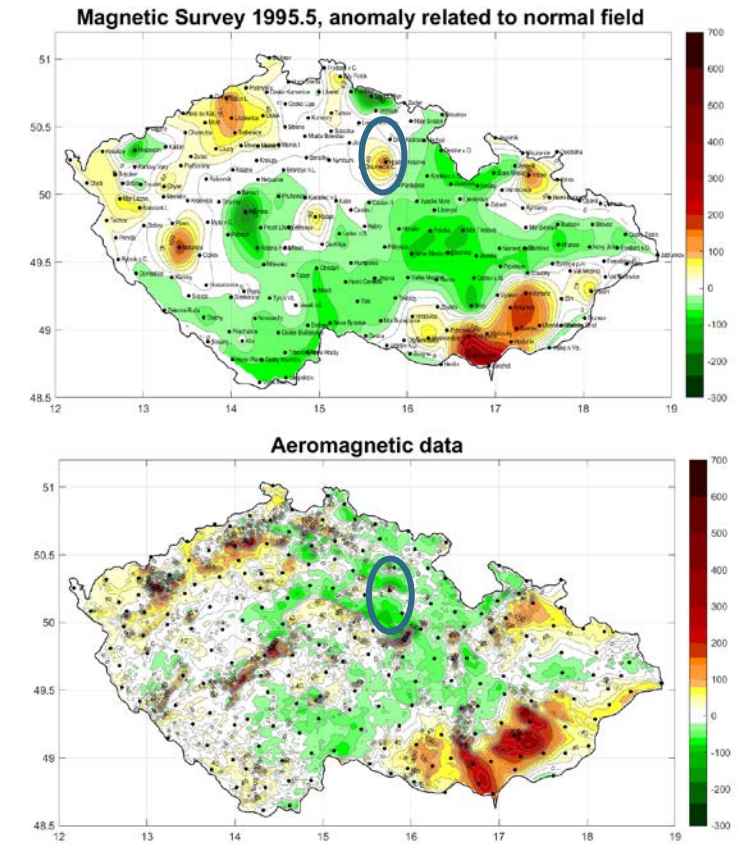
Complexity of this region was taken into account during establishment of the network. The points are placed out of the most magnetic structures. An unexpected anomaly of -100 nT appeared at the station Revnice. As the aeromagnetic survey did not observe any anomaly, it must be of a very local source. The point will be removed from the data for map construction.



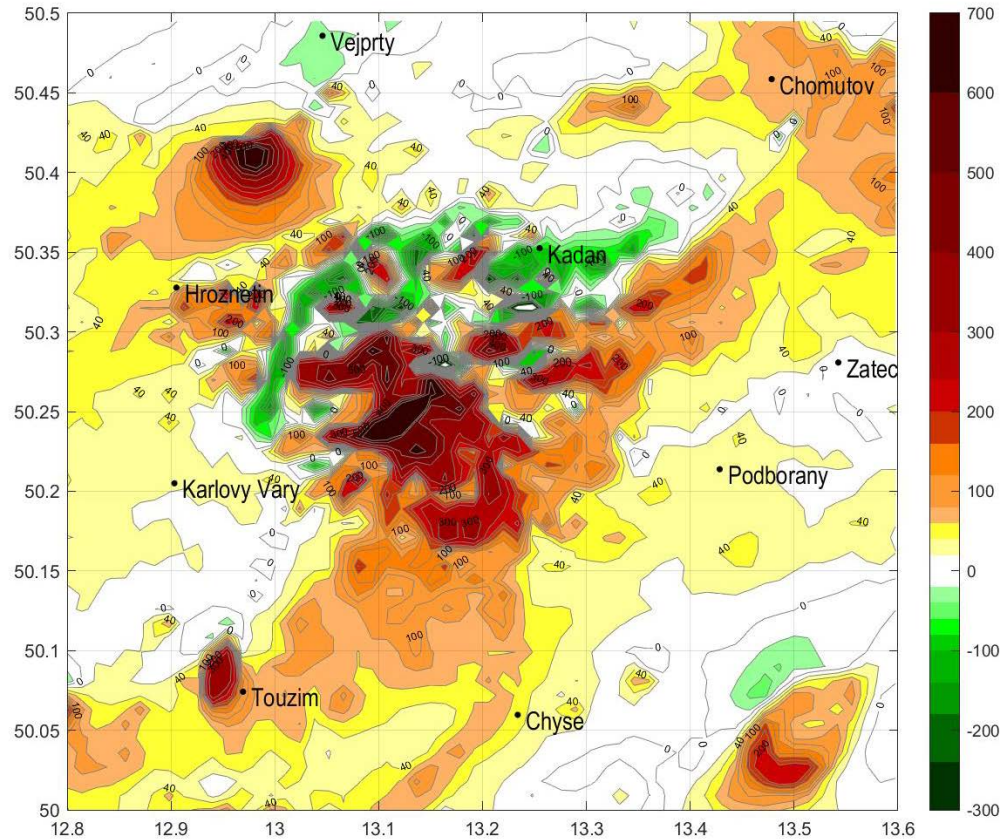
Intricate region: Hradec Králové



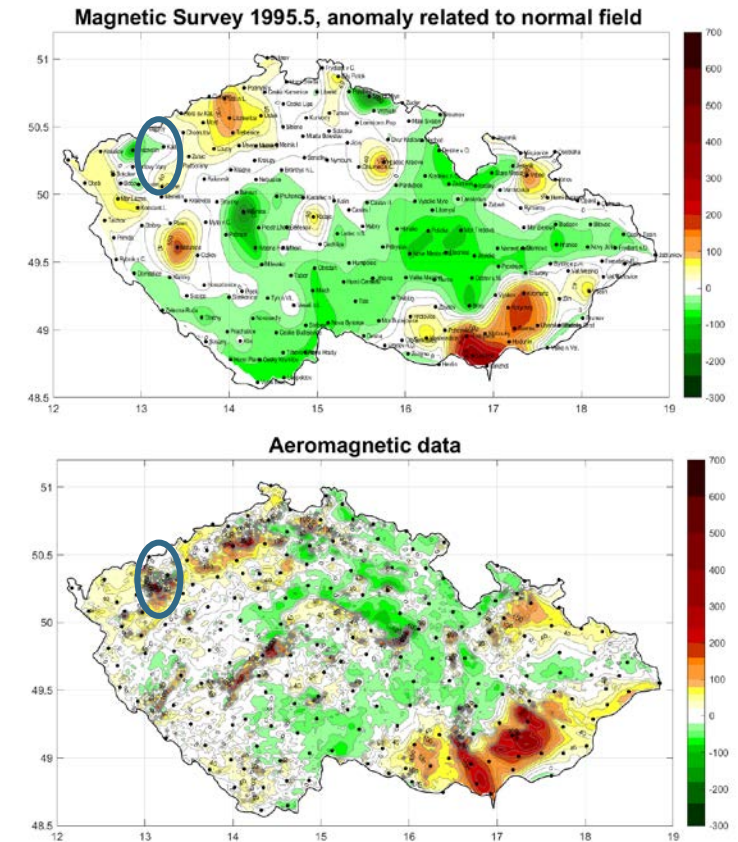
The point is situated in a round magnetic anomaly with diameter 5 km, whereas the contouring program widens it to 30 km (as a result of the network density).
The point will be removed from the data for map construction.



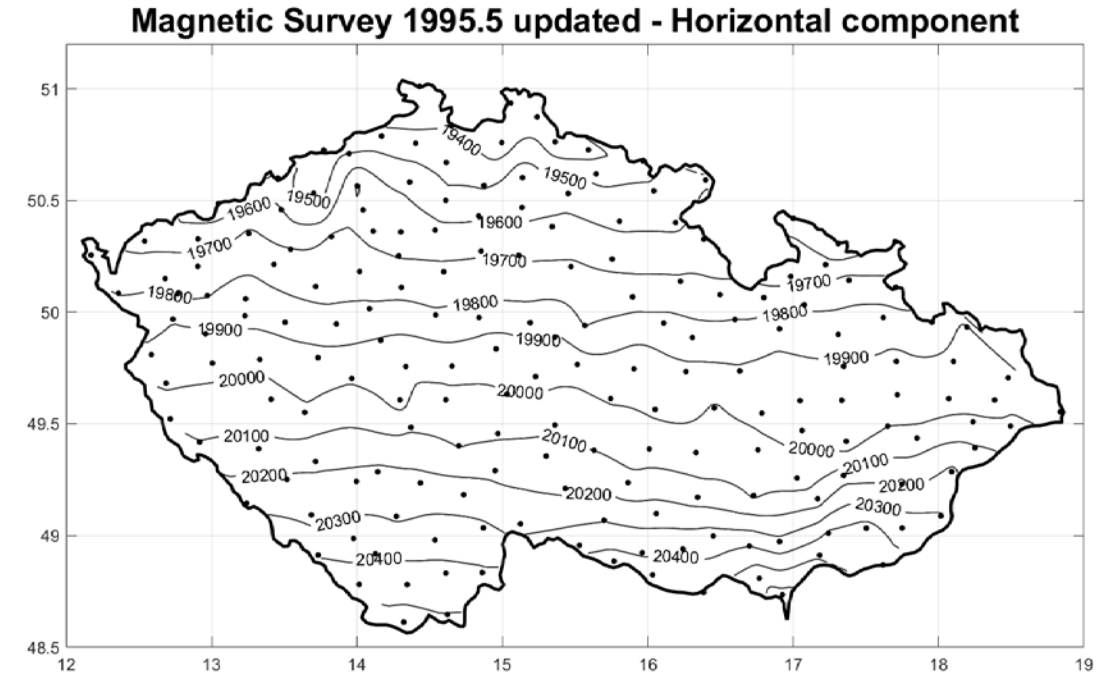
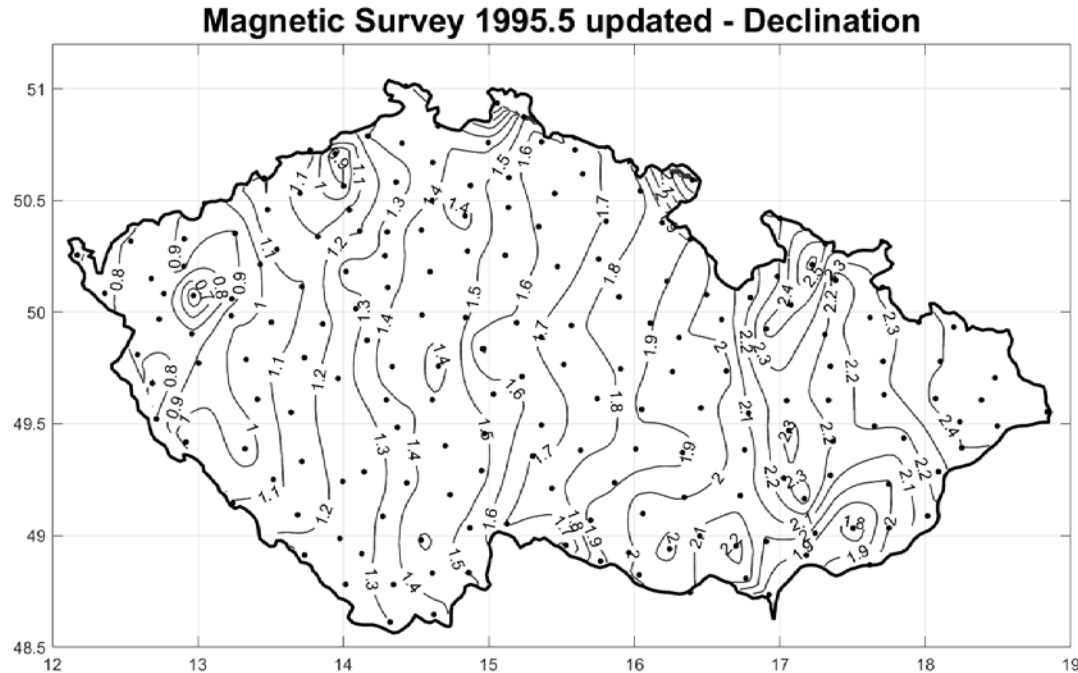
Intricate region: Doupov Mts.



The ground magnetic survey in Doupov Mts. is impossible for high magnetization of the neovolcanic rocks. The neighbouring points show standard results with exception of Hroznětín. Whereas the point is in the area of positive anomaly on aeromagnetic map, the ground measurements shows anomaly -100 nT. The point was therefore deleted from updated map.

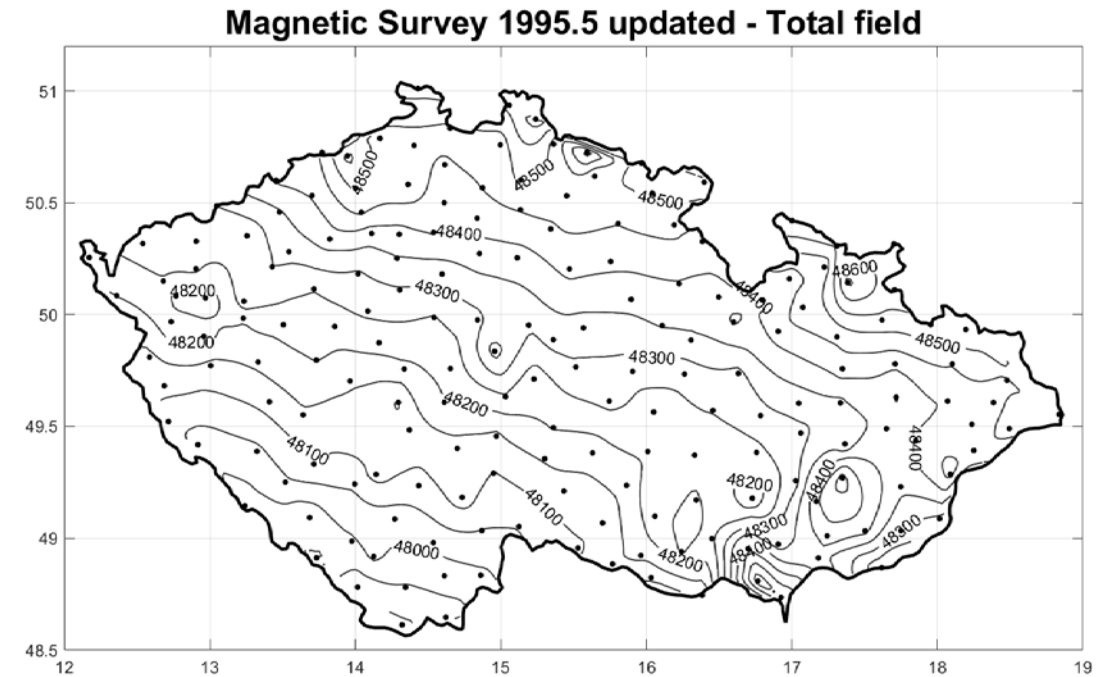
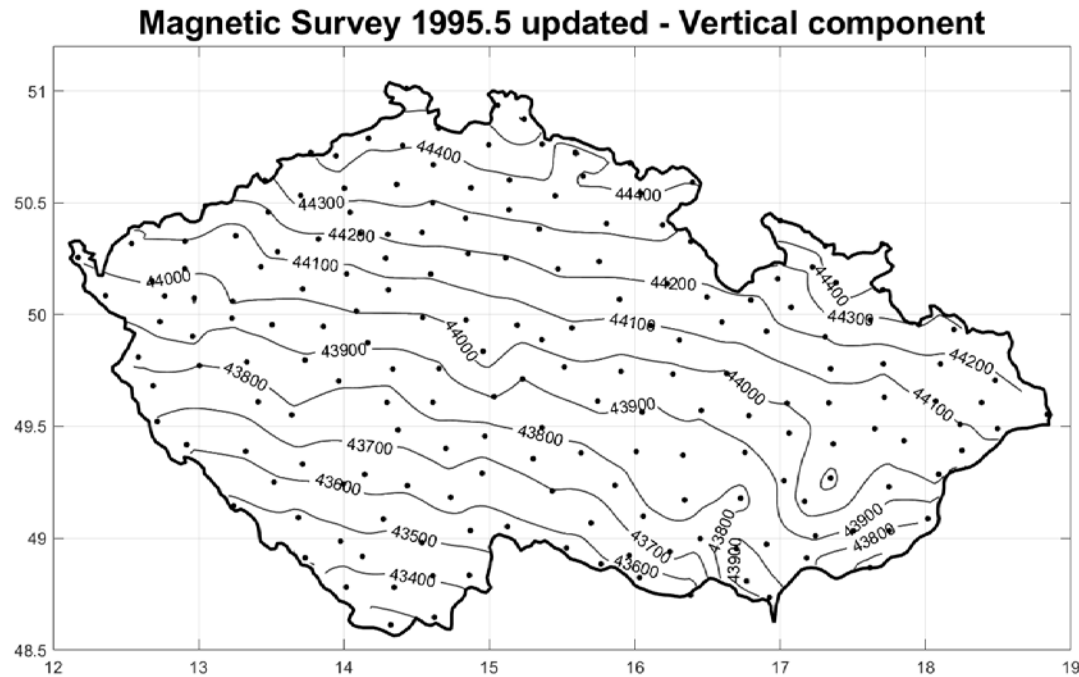


Ground Magnetic Survey 1994–1996 updated



Although the exclusion of “anomalous” points was carried out just on the basis of observation of total field, the results become evident in all components. The contour lines were partly straightened out, especially in declination and total field.

Ground Magnetic Survey 1994–1996 updated



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CONCLUSIONS

- Ground-based and air-borne magnetic surveys are complementary approaches for obtaining information about the geomagnetic field.
- Ground-based magnetic survey provides data about the magnitude and direction of the geomagnetic field on given site and time. The data are obtained with very high accuracy (about 1 nT). However, it is not clear, how representative is the information for the neighbourhood of this site.
- On the other hand, the aeromagnetic survey observes just magnitude of geomagnetic field on a dense network of points. The accuracy is of about 1 order worse.
- Comparison of the magnitude of geomagnetic field at the points of the fundamental network with mean value of local aeromagnetic data was used to indicate points which were not representative for given region. Detailed analysis of the neighbourhood of these points enabled to exclude several “anomalous” points from this map of magnetic anomalies.

Thank you