Model of the Geomagnetic reference field of the Republic of Serbia

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INTRODUCTION

In the period from Year 2018-2021, during three campaigns of geomagnetic measurements at the Reference Geomagnetic Network of Repeat Stations of the Republic of Serbia, the *Second Secular Geomagnetic Survey* was carried out. The reference geomagnetic network of repeat stations consists of 14 repeat stations and a reference point represented by the Grock Geomagnetic Observatory (GMO (GCK)) (Figure 1). From June to October 2018, during the first measurement campaign, geomagnetic measurements were carried out at five repeat stations in Vojvodina. During the second campaign, which lasted from May to October 2019, a geomagnetic survey was carried out at five more repeart stations. The third, final, measurment campaign was carried out from May to July 2021 at four repeat stations.

METHODOLOGY

The *Second secular geomagnetic survey* in Serbia contains a series of three-component absolute measurements and continual measurements at the base station of the geomagnetic field at repeat points and second and/or minute registrations of the variations in geomagnetic field components over a period of three to five measurement days at each repeat station.

The results of the three-component geomagnetic measurements, as well as the measurements of the variations of the components of the geomagnetic field every second, are processed, analyzed and compared with the geomagnetic measurements at GCK.

Processing of geomagnetic survey results at repeat stations includes statistical analysis of daily variations, registered by three-component and scalar magnetometers at a specific repeat station and GMO (GCK). Minute, average hourly, daily, monthly and annual values were used in the analysis and reduction process.

In the reduction method, relations (1 and 2) were used to determine the difference between the current value of the geomagnetic field component **E(t)** and the corresponding mean annual value **E** at the repeat station, in relation to the difference between the corresponding values $\mathbf{E_0(t)}$ and $\mathbf{E_0}$, at the reference observatory-GMO (GCK):

$$E(t) - E = E_0(t) - E_0 \quad (1)$$

$$E = E_0 + E(t) - E_0(t) \quad (2)$$

After the reduction of geomagnetic survey data at repeat stations for a certain epoch, the calculation of secular variations follows, as well as the normal and anomalous values of the components of the geomagnetic field vector at the Reference Geomagnetic Network of Repeat Stations.

Based on the results of the geomagnetic survey and the reduced values of the geomagnetic field components at the repeat stations and at the GCK observatory, the values of the coefficients for the normal field distribution model for the territory of Serbia for a certain epoch are calculated. For this purpose, the Gaussian method of spherical harmonic analysis of the normal field value is most often used. The normal field value distribution model for Serbia, for the selected epoch, is calculated based on the following second-order polynomial function:

$$F(\varphi;\lambda) = a_1 + a_2\,\Delta\varphi + a_3\,\Delta\lambda + a_4\,\Delta\varphi^2 + a_5\,\Delta\lambda^2 + a_6\,\Delta\varphi\Delta\lambda \quad (3)$$

The distribution of the measured values of the northern component [X] of the geomagnetic field vector, for the epoch 2018.5 is shown in Figure 2.

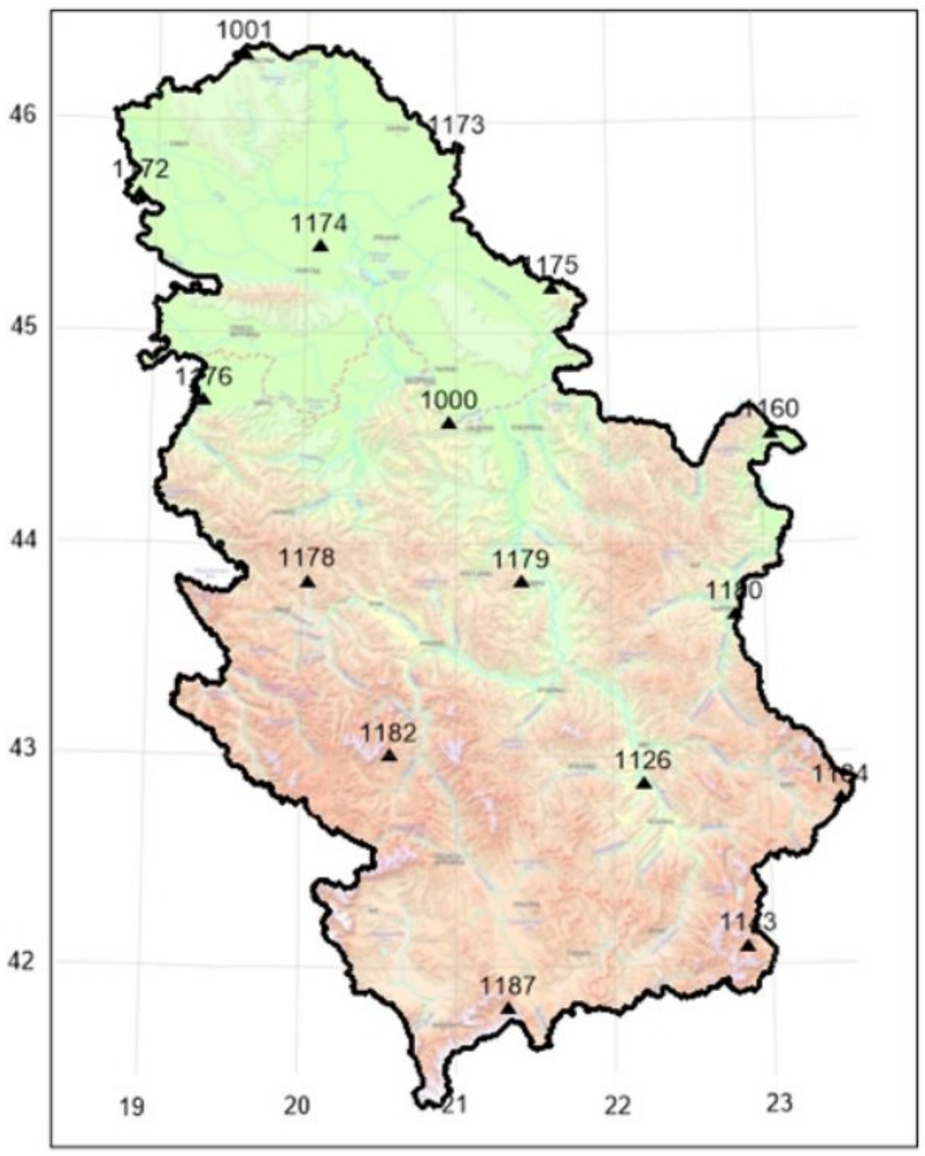

Figure 1. Reference Geomagnetic Network of Repeat Stations in Republic of Serbia (geomagnetic field measurements were not carried out at point 1187)

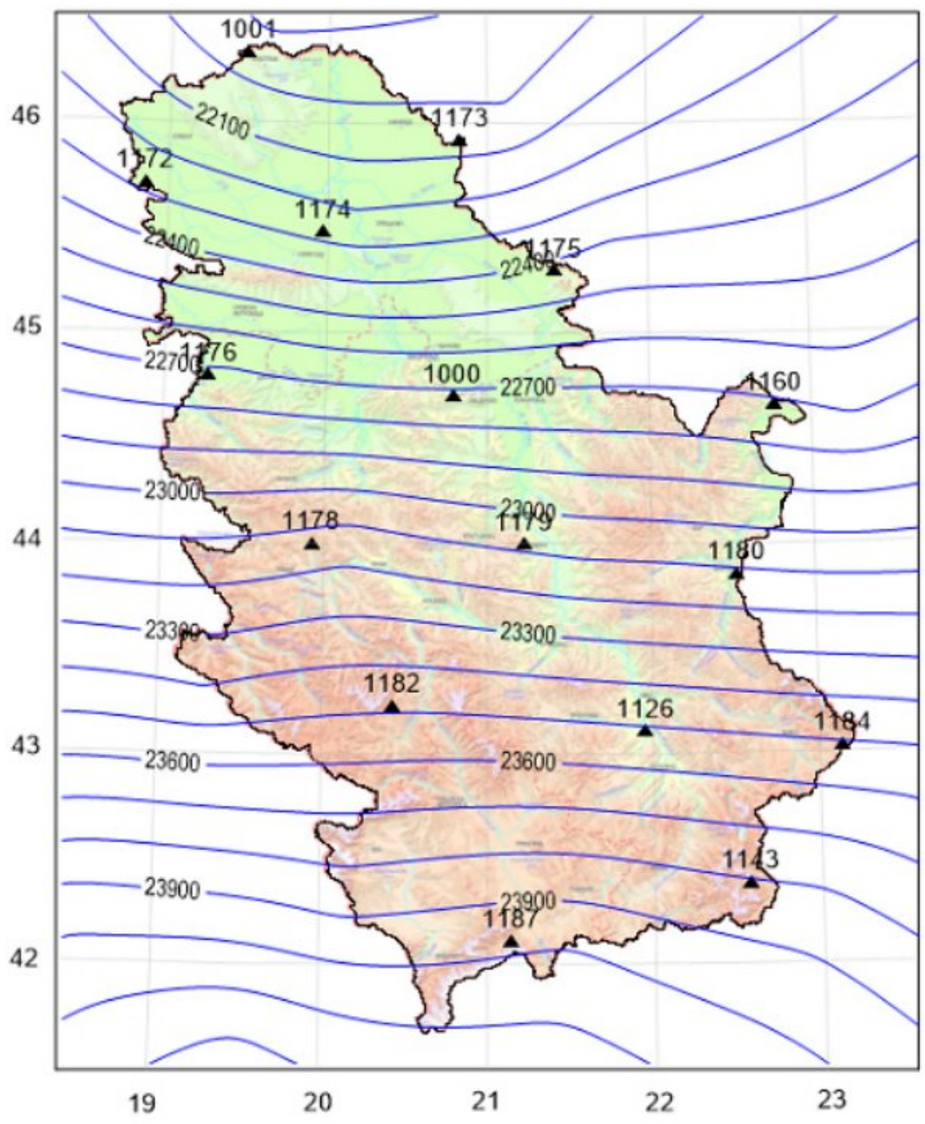

Figure 2. Geomagnetic map of the distribution of absolute values of the northern component (X) of the geomagnetic field of the Republic of Serbia for the epoch 2018.5.

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