Current practice of the Hungarian Repeat station surveys: measurement, data processing, interpretation

Péter Kovács, András Csontos, Gergely Vadász, Balázs Heilig

In Hungary, the tradition of the geomagnetic survey campaigns dates back to the middle of the nineteenth century. Between 1950 and 1995, Hungary's vector magnetic components have been surveyed periodically, every 15 years, on the so-called country survey (CS) network comprising 300 stations. In 1965, a repeat-station (RS) network was also installed in order to monitor the spatial distribution of the secular change of the magnetic field and to regularly update the field measured in the dense CS network. In the paper, we present the RS network of Hungary, and our recent improvements applied in the measurement technique and data processing.

The RS network of Hungary (H-RS) is shown in Figure 1 (Aczél, Stomfai, 1969). The network comprises 13 stations that are located on non-anomalous sites. The re-occupation period of H-RS is 2 years, in accordance with the recommendation of MagNetE. We use one-axial fluxgate magnetometer mounted on the telescope of a Theo020A Zeiss theodolite to measure the magnetic declination and inclination (in the null mode, see Newitt et al., 1996), and GSM 19 Overhauser type of magnetometer to record the total field. In each station, the measurements are carried out in the morning and afternoon hours in consecutive days in order to minimize the error of the temporal reduction. Basically, the temporal reduction is carried out with the use of the magnetic recording of the Tihany Observatory (THY). Additionally, we also install a three-component DIDD magnetometer in the Baradla cave (near to Aggtelek RS) and use its record for the reduction of the nearby measurements (see Fig. 1.). The limestone cave environment ensures low level of magnetic and mechanical noise, as well as temperature stability.

Figure 1: The Hungarian repeat station network (H-RS). The picture shows the on-site DIDD variometer installed near to Aggtelek station. The blue rectangle represents the area where the on-site recording is applied in the data reduction.

It is shown, that, by applying the on-site recording, the gain in the temporal reduction accuracy can exceed 2 nT in X, Y or Z components, depending on the geomagnetic activity conditions.

The normal field models of Hungary are compiled by the first- or second-order polynomial of the geographic coordinates. The polynomial fitting is carried out separately for each of the vector component, thus this solution ignores the Laplace's condition. To avoid this shortcoming, recently, we have developed a Matlab code for the application of the adjusted spherical harmonic analysis (ASHA), introduced by De Santis (1992) for the modelling of the geomagnetic field for a spherical cap domain. To improve the model accuracy for Hungary, we involve RS and observatory data of neighbouring countries, from the database of WDC for Geomagnetism. Moreover, in empty area we also set up "virtual stations" and filled them with magnetic values derived from the recent IGRF model (Thébault et al., 2015).

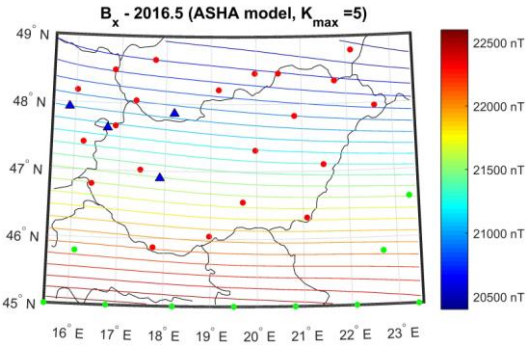

Figure 2: The X component model field for Hungary compiled according to ASHA (see text). The red dots, blue triangles and green dots show the locations of repeat stations, observatories and "virtual stations" (see text), respectively, from where data have been used in the model computation.

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Author:
P. Kovács[1], A. Csontos[1], G. Vadász[2], B. Heilig[1]
1) Mining and Geological Survey of Hungary, Budapest, Hungary
2) Eötvös Loránd University, Faculty of Science, Institute of Physics, Budapest, Hungary

Corresponding author:
Péter Kovács
Mining and Geological Survey of Hungary
Columbus str. 17-23, 1145 Budapest, Hungary, Tel.: +36 (1) 252 4999
e-mail: kovacs.peter@mbfsz.gov.hu