Data article

Data set about local mapping of the Earth's magnetic field

Daniel Polčín

Department of Informatics, Faculty of Education, Catholic University in Ruzomberok, Hrabovská 1, 034 01 Ruzomberok, Slovakia

A R T I C L E   I N F O

Article history:
Received 3 October 2016
Received in revised form 25 October 2017
Accepted 31 January 2018
Available online 8 February 2018

Keywords:
Magnetic field
Magnetic induction
Measurement
Measuring instruments
Faraday's law
Monitoring

A B S T R A C T

The data presented in this article are related to the research article entitled "Magnetic field and its experimental measurement in teaching in high schools" (J. Beňuška, D. Polčín, 2016) [1].

The article describes the possibilities of relatively accurate experimental measurement of magnetic field in any geographical conditions, in both exteriors and interiors, without the need for special instrumentation, with minimal financial costs.

The data set is publicly available to allow the comparison of magnetic induction values in given latitudes with the other latitudes by the given methods and a critical analysis of the applicability of these methods in areas and locations without more demanding instrumentation.

© 2018 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

E-mail address: polcin.daniel@gmail.com

https://doi.org/10.1016/j.dib.2018.01.112

2352-3409 © 2018 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).
### Specifications Table

| Subject area              | Geophysics, Applied Geophysics |
|---------------------------|--------------------------------|
| More specific subject area| Local and regional geomagnetic mapping for a more accurate description of dynamic magnetic field changes |
| Type of data              | Tables, charts, text file      |
| How data was acquired     | 1 Measurement of the horizontal component of the magnetic induction of the Earth’s magnetic field by a thread rotation |
|                           | 2 Measurement of the horizontal component of the magnetic induction of the geomagnetic field, using a circular coil |
| Data format               | Raw, analysed                  |
| Experimental factors      | The magnitude of the magnetic field induction of the Earth’s magnetic field was measured by two simple methods to compare their accuracy. |
| Experimental features     | The regional dynamics of magnetic field changes were monitored by comparing of measurements in different time periods. There were regional dynamics of the Earth’s magnetic field changes observed in the given area. |
| Data source location      | Ružomberok, Slovakia, 49°04'57.9"N; 19°17'36.0"E |
| Data accessibility        | The data are available with this article. |

### Value of the data

- The data provide information about the horizontal magnetic induction component of the Earth’s magnetic field in the region and may be used by other scientists at geomagnetic mapping.
- The observed dynamics of local magnetic field changes can supplement the data on its spatial and temporal dynamic properties for specialized observatories.
- These data allow other researchers to complement the network of geomagnetic observations and thus partly specify the magnetic field distribution map

### 1. Data

The data set of this article provides information about the measured magnitude of the horizontal magnetic induction component of the Earth’s magnetic field in the selected geographical location.

![Magnetic induction](image)

**Fig. 1.** Measured values of horizontal component of magnetic induction $B_h$ of the Earth’s magnetic field by a thread rotation - Dec 18, 2015.
Fig. 2. Measured values of horizontal component of magnetic induction Bh of the Earth’s magnetic field by a circular coil - Dec 18, 2015.

Fig. 3. Measured values of horizontal component of magnetic induction Bh of the Earth’s magnetic field by a thread rotation - Jun 24, 2016.

Fig. 4. Measured values of horizontal component of magnetic induction Bh of the Earth’s magnetic field by a circular coil - Jun 24, 2016.
### Table 1
Measured values of horizontal component of magnetic induction $B_h$ of the Earth’s magnetic field by a thread rotation - Dec 18, 2015 (The triangle surface: $S = 4.07 \text{ m}^2$).

| n  | 10T/s | T /s | U/mV | $B_h$/nT |
|----|-------|------|------|----------|
| 1  | 10.87 | 1.087| 0.30 | 20030.71 |
| 2  | 10.89 | 1.089| 0.30 | 20067.57 |
| 3  | 10.51 | 1.051| 0.31 | 20012.90 |
| 4  | 10.86 | 1.086| 0.30 | 20012.29 |
| 5  | 11.24 | 1.124| 0.29 | 20022.11 |
| 6  | 10.85 | 1.085| 0.30 | 19993.86 |
| 7  | 10.50 | 1.050| 0.31 | 19993.86 |
| 8  | 10.52 | 1.052| 0.31 | 20031.94 |
| 9  | 10.53 | 1.053| 0.31 | 20050.98 |
| 10 | 11.26 | 1.126| 0.29 | 20057.74 |
| Average | | | | 20027.40 |

$B_h = \frac{\mu NI}{d^2}$

N circular coil threads number.
I current passing through coil threads
d coil diameter
$\mu$ environment permeability (for air approximately as vacuum $4.3,14.10^{-7}$ N.A.$^{-2}$).

### Table 2
Measured values of horizontal component of magnetic induction $B_h$ of the Earth’s magnetic field by the circular coil - Dec 18, 2015.

| n  | N  | d/m | I/mA | $B_h$/nT |
|----|----|-----|------|----------|
| 1  | 31 | 0.2 | 102.89| 20030.63 |
| 2  | 31 | 0.2 | 102.92| 20036.47 |
| 3  | 31 | 0.2 | 102.91| 20034.52 |
| 4  | 31 | 0.2 | 102.88| 20028.68 |
| 5  | 31 | 0.2 | 102.86| 20024.78 |
| 6  | 31 | 0.2 | 102.90| 20032.57 |
| 7  | 31 | 0.2 | 102.95| 20042.31 |
| 8  | 31 | 0.2 | 102.92| 20036.47 |
| 9  | 31 | 0.2 | 102.86| 20024.78 |
| 10 | 31 | 0.2 | 102.85| 20022.84 |
| Average | | | | 20031.40 |

$B_h = \frac{\mu NI}{d^2}$

### Table 3
Measured values of horizontal component of magnetic induction $B_h$ of the Earth’s magnetic field by a thread rotation - Jun 24, 2016 (The triangle surface: $S = 4.07 \text{ m}^2$).

| n  | 10T/s | T /s | U/mV | $B_h$/nT |
|----|-------|------|------|----------|
| 1  | 11.20 | 1.120| 0.29 | 19950.86 |
| 2  | 10.81 | 1.081| 0.30 | 19920.15 |
| 3  | 10.85 | 1.085| 0.30 | 19993.86 |
| 4  | 11.17 | 1.117| 0.29 | 19897.42 |
| 5  | 11.58 | 1.158| 0.28 | 19916.46 |
| 6  | 10.82 | 1.082| 0.30 | 19938.57 |
| 7  | 11.59 | 1.159| 0.28 | 19933.86 |
| 8  | 10.79 | 1.079| 0.30 | 19883.29 |
| 9  | 11.62 | 1.162| 0.28 | 19985.26 |
| 10 | 11.60 | 1.160| 0.28 | 19950.86 |
| Average | | | | 19937.04 |

$B_h = \frac{UT}{4S}$
Figs. 1–4 with corresponding Tables 1–4 show the measured values in two time periods - December 18, 2015 and June 24, 2016.

2. Experimental design, materials and methods

2.1. Measurement of the horizontal component of the magnetic induction of the Earth’s magnetic field by a thread rotation

The experiment is designed to measure the magnitude of the magnetic induction of the Earth’s magnetic field in our latitude by means of a rotating conductor in which the voltage is induced by Faraday’s law of electromagnetic induction, with changes in magnetic induction current through the surface described by the conductor.

Materials:

fixed wire (20 m) loaded in the middle by a tennis ball, milivoltmeter, stopwatch, length gauge, compass to determine the correct direction - the surface plane of the thread must be perpendicular to the direction south-north.

When spinning the wire in the magnetic field of the Earth in the south-north direction, there is a constant change in the thread area through which the magnetic induction lines pass. This changes the magnetic induction flux and induces the voltage we measured in the thread. The magnetic induction value was calculated from it.

2.2. Measurement of the horizontal component of the magnetic induction of the geomagnetic field, using a circular coil

The principle consists in comparing the magnitude of the magnetic field induced by the electric current passing through the coil and the magnitude of the horizontal component of the Earth’s magnetic field.

| n | N | d/m | I/mA | Bh/nT |
|---|---|-----|------|-------|
| 1 | 31 | 0.2 | 102.45 | 19944.97 |
| 2 | 31 | 0.2 | 102.47 | 19948.86 |
| 3 | 31 | 0.2 | 102.43 | 19941.07 |
| 4 | 31 | 0.2 | 102.46 | 19946.91 |
| 5 | 31 | 0.2 | 102.43 | 19941.07 |
| 6 | 31 | 0.2 | 102.44 | 19943.02 |
| 7 | 31 | 0.2 | 102.47 | 19948.86 |
| 8 | 31 | 0.2 | 102.43 | 19941.07 |
| 9 | 31 | 0.2 | 102.42 | 19939.13 |
| 10 | 31 | 0.2 | 102.46 | 19946.91 |

Average 19944.19

$B_h = \mu_0 \frac{NI}{d}$

N circular coil threads number
I current passing through coil threads
d coil diameter
$\mu$ environment permeability (for air approximately as vacuum $4.3 \times 10^{-7}$ N.A$^{-2}$)
Materials:
- circular coil (31 threads, diameter 20 cm), paper box, compass,
- Ue = 4.5 V voltage source (battery), 100 Ω potentiometer, ampermeter (up to 300 mA).

By setting the electric current in a circular coil so that the magnet against the north is at an angle of 45°, we get the equation of magnetic induction magnitude of the magnetic field of the coil BC and of the Earth BZ. From this equation, magnetic induction values were calculated.

Finally, we compared the data measured with both methods. We analyzed the dynamics of magnetic field changes by comparing data acquired in two different time periods.

Transparency document. Supporting information

Transparency data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.dib.2018.01.112.

References

[1] J. Beňuška, D. Polčín, Magnetic field and its experimental measurement in teaching in high schools, Eur. Int. J. Sci. Technol. (2016) 116–130.