Experiments with Sensing and Evaluation of Ionosphere Changes and Their Impact on the Human Organism

[1]M. Hanzelka, [2]J. Dan, [1]P. Fiala, [1]M. Steinbauer, [3]V. Holcner

[1]Department of Theoretical and Experimental Electrical Engineering, Brno University of Technology, Brno, Czech Republic
[2]Rector´s Office, Personnel Management Office, Masaryk University, Brno, Czech Republic
[3]Faculty of Economics and Management, University of Defence, Brno, Czech Republic
Email: fialap@feec.vutbr.cz

Abstract. *The impact of the environment upon living organisms constitutes a crucial problem examined by today's science. In this context, research institutes worldwide have analysed diverse positive and negative factors affecting the biological system of the human body. One such factor consists in the influence of the surrounding electromagnetic field. This paper presents the results of an investigation focused on ionosphere parameter changes and their impact on the basic function of the nervous system. It is a well-known fact that the frequency of the alpha waves of brain activity [1] ranges within 6 – 8 Hz. Changes in the electromagnetic and chemical structure of the Earth's surface may cause variation of signals in the above-defined frequency region of 6 – 8 Hz.*

Keywords: Ionosphere, Human Body, Brain Activity

1. Introduction

The low-level measurement of low frequencies (0.01-10 Hz) performed to evaluate the effect of magnetic fields on the human organism can be regarded as an interdisciplinary branch of science that embraces different types of research. By further extension, the low-level measurements are interesting from the perspectives of theoretical electrical engineering and research of magnetic fields. At this point, is important to consider applied research disciplines, for example the measurement and radar technology in the following ranges: the ULF (Ultra Low Frequency Band: 300 Hz - 3 KHz), SLF (Super Low Frequency Band: 30 Hz - 300 Hz, and ELF (Extreme Low Frequency Band: 0.1 Hz - 30 Hz). Scientists and researchers are currently preparing to solve special tasks related to the objectivisation of the impact of low-level magnetic fields upon the human organism; such impact will be examined from the perspective of physical harm to cells [2] and mental condition of humans [2], [3], Fig. 1.

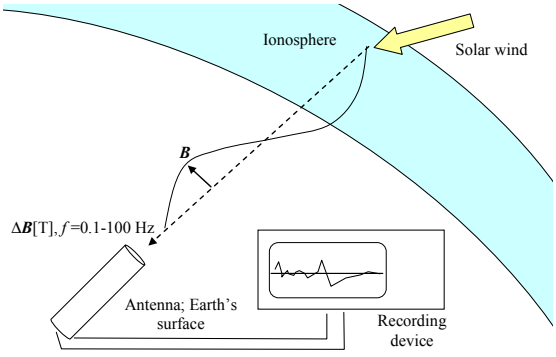


Fig. 1. Schematic arrangement of the problem of detecting the changes in the Earth's ionosphere.

2. Research of Geomagnetic Effects

Ionosphere changes can be objectively measured using already known methods [4]. Based on earlier observations, it is possible to demonstrate via secondary research that a connection exists between magnetic field changes and the social behaviour of groups of humans. According to Alexander Tchijevsky, 80% of the most significant events in human history occurred within the approximately five years of the maximum solar activity; this assumption is represented by the related diagram (1750-1922), [5] (Tchijevsky A, 1971), and later measurement Fig. 2.

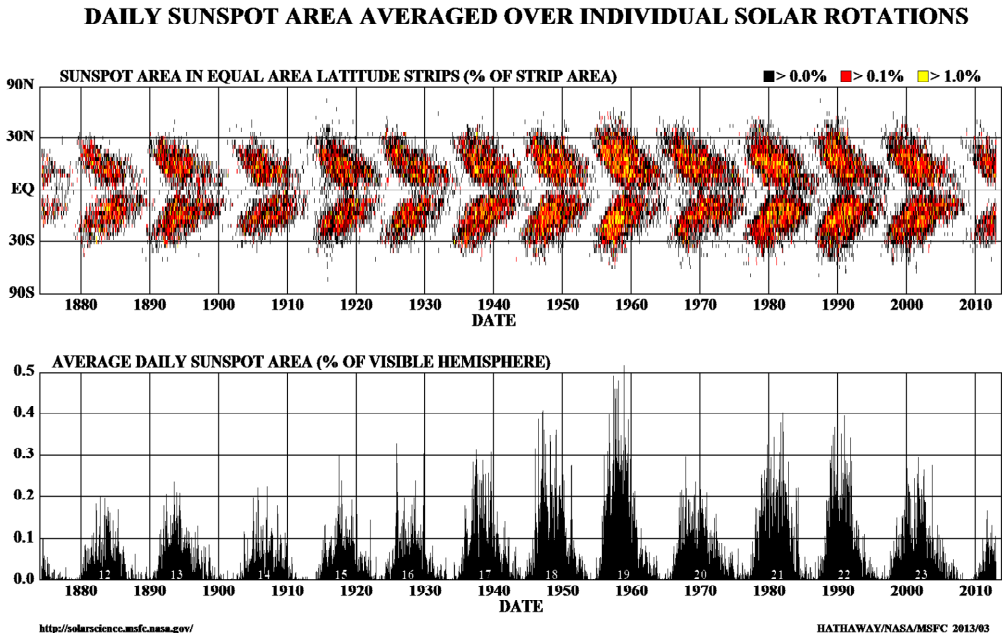


Fig. 2 The development of geomagnetic storms - Royal Observatory , Greenwich monitored from May 1874 in daily measurements and continuously since 1976 - Solar Optical Observing Network (SOON), supported by the US National Oceanic and Atmospheric Administration (NOAA).

3. Description of the Experimental Research

The laboratory research comprising a homogeneous sample of 49 subjects (men and women aged 19 to 25) was launched on April 22, 2014 and lasted until June 26, 2014. The total time required for the examination of psychophysiological parameters in a subject corresponded to 19 minutes. We used a Nickelodeons Infiniti (Thought Technology Ltd.) unit to perform the entire task, and the measurement proper involved four phases: Rest; Color; Rest; Math; and Rest. At the Color stage, a special (Stroop) test was utilized to acquire the psychophysiological responses of each subject to a load on their organism. Generally, this tool demonstrates that a person performing the given task can be easily distracted due to their automatic reactions and habits; the procedure is named after John Ridley Stroop (1897-1973), an American psychologist who first described the phenomenon in 1929. In the Math phase, then, the respondents were asked to progressively subtract the number 7 from the initial value of 1081, and we examined the psychophysiological stress generated during such quiet countdown. The total number of measurements was 210, with the average of 4.29 per respondent.

The relationship between the former indicator and the number of subjects who completed the task is shown in Tab. 1. The respondents were measured in special laboratories to ensure comparable parameters and constant temperature, noise, humidity, lighting, concentration of positive and negative ions, and a homogenized component of the geomagnetic field, Fig. 4b).

Tab. 1. The relation between the number of completed measurements and the number of respondents.

Number of respondents	Number of measurements
4	1
1	2
4	3
12	4
24	5
4	6
49	SUM

4. Description of the Measurement Procedures for the Given Sample of Respondents

To measure the psychophysiological characteristics of the human body on the respondents, we used the BioGraph Infiniti devices providing bio- and neurofeedback. The following variables were measured:

B: BVP amplitude mean (Rel), B: BVP HR mean (beats/min), B: BVP HR std. dev., B: BVP peak freq. mean (Hz), B: BVP IBI std. dev. (SDRR), B: BVP VLF % power mean, B: BVP LF % power mean, B: BVP HF % power mean ,B: BVP VLF total power mean, B: BVP LF Total power mean, B: BVP HF total power mean, B: BVP LF/HF (means), Total spectral power, C: EMG mean (uV), D: EMG mean (uV), E: Skin conductance mean (uS), E: SC as % of value mean (%),F: Temperature mean (Deg), F: Temp as % of value mean (%),G: Resp rate mean (br/min), B&G: (HR max-min) mean (b/min), G: Abd amplitude mean (rel), H: Thor amplitude mean (rel), G&H: Abd-tho ampl diff (means). The measurement comprised three relaxation and two stress phases, with an emphasis on intensive psychological stress in the respondents. The stress stages were laboratory-generated using a low-level electromagnetic field generator, an amplifier, and Helmholtz coils to interact with the EEG brain waves of the respondent. The resulting low-level field enabled us to simulate the effect of changes in solar activity as an additional offset to the related real intensity indicators prepared for each day by NASA.

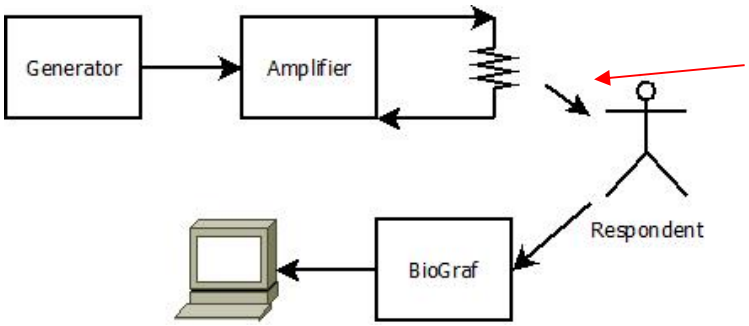
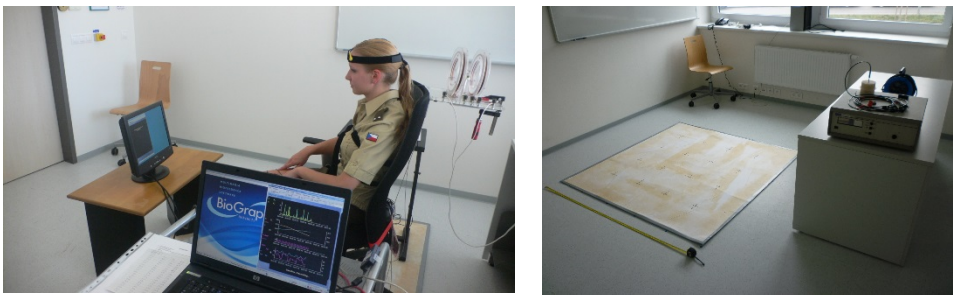


Fig. 3. Scheme of measurement and simulation apparatus.



a) b)

Fig. 4. a) Documentation shots from measurements in laboratory conditions, b) Laboratory space of measurements with geomagnetically stable component of the magnetic field.

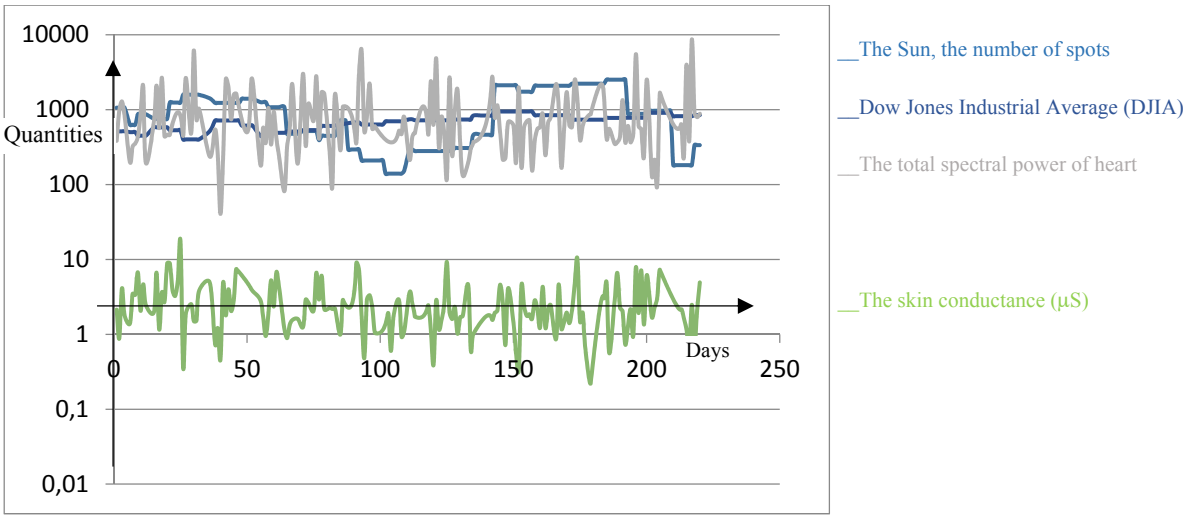


Fig. 5. Evaluation of measurement parameters of individual characteristics and Solar Activity (over 230 days).

The field strength in the Helmholtz coil was set to the level of terrestrial magnetic field, and the major parameters were as follows: impulse $f = 1$ kHz; start = 100 ns; $\lambda / 2 = 168$ μs. Fig. 3 shows a diagram of the stimulation and measurement apparatus. Fig. 4 then presents shots of the BioGraph Infiniti measurements.

5. Conclusion

The prepared experiments and its measurement can prove the influence of the above-mentioned aspects on the human emotional system, thus pointing to the hitherto applied boundary values of magnetic flux density B in relation to the alterations of the magnetic field for very slowly changing electric currents, Fig.5. The experiments also highlight the impact these currents might have on human beings permanently present in such environment.

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