

# USING MOBILE PHONE TO DETECT THE USER'S INDIVIDUAL RESPONSE TO SPACE WEATHER VARIATIONS

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## Abstract

It is shown that there are apparent correlation between cellular networks users' communication activity and the geomagnetic field variations. It is shown that the determination of the appropriate correlation coefficients allows one to define the individual characteristics of users' reactions to space weather variations. This reaction is characterized by a wide dispersion (as there are meteo-dependent people, there are also people keenly reacting to geomagnetic field variations). It is shown that the identification of individual reactions of the specified type can make the content of the new SMS-services.

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**Keywords:** Correlation coefficients, geomagnetic field variations, network users' activity, SMS-services

## Introduction

At the present time the range of services accessible through mobile phones and other modern means of communication are significantly expanding. The examples are the advertisements carried out by means of SMS-mailing, SMS-games, distant medical consultations etc.

At the moment it is also firmly established that the space weather variations, in particular, geomagnetic field variations, have a significant impact on the psycho-physiological condition of the individual [1-3]. The information presented in the cited monographs, clearly show that the fluctuations of geo - and heliophysical parameters really affect the behavior of people, up to the existence of the expressed correlations between statistics of suicides and parameters characterizing the state of the space weather.

However, it should be emphasized that the correlation dependences obtained in the field of heliobiology, as a rule, are of a statistical nature, and are often obtained on the basis of experiments relating to limited groups of examinees. The possibility to identify the individual features of a particular person's reaction to space weather variations are still limited and often require independent surveys.

This work shows that, there are at least two ways to ensure the definition of individual dependence on space weather on the basis of the parameters characterizing the interaction of a specific user with the communication space in automatic mode.

It is also shown that the service can be provided for users by CMC-delivery, which meets the modern trends, reflected in the expansion of the range of these kinds of services.

## Data and Results

Curve 1, Figure 1 shows an example of the dependence of «2GETHER» dating site attendance on time. Calculation of the coefficient of correlation between the presented data and K-index of disturbances of the geomagnetic field gave a value of  $r = 0,72$  for the period from September 1 to October 1, 2013. The dependence of K-index on time for correspondent period is also shown at the figure (curve 2). K-index data was obtained from the site the N.V.

Pushkov Institute of terrestrial magnetism, ionosphere and radio wave propagation of the Russian Academy of Science (IZMIRAN). The obtained value of the coefficient of correlation in heliobiology is considered fairly high and indicating the existence of the response of the considered event to space weather variations.

The obtained result is settled well within the overall number of information presented, for example, in the works [4-6]. Namely, on the basis of the data of the cited works it is reasonable to assume that once the geomagnetic field variations influence on psychophysiological state of a person, then they are statistically reflected on the network users' activity.

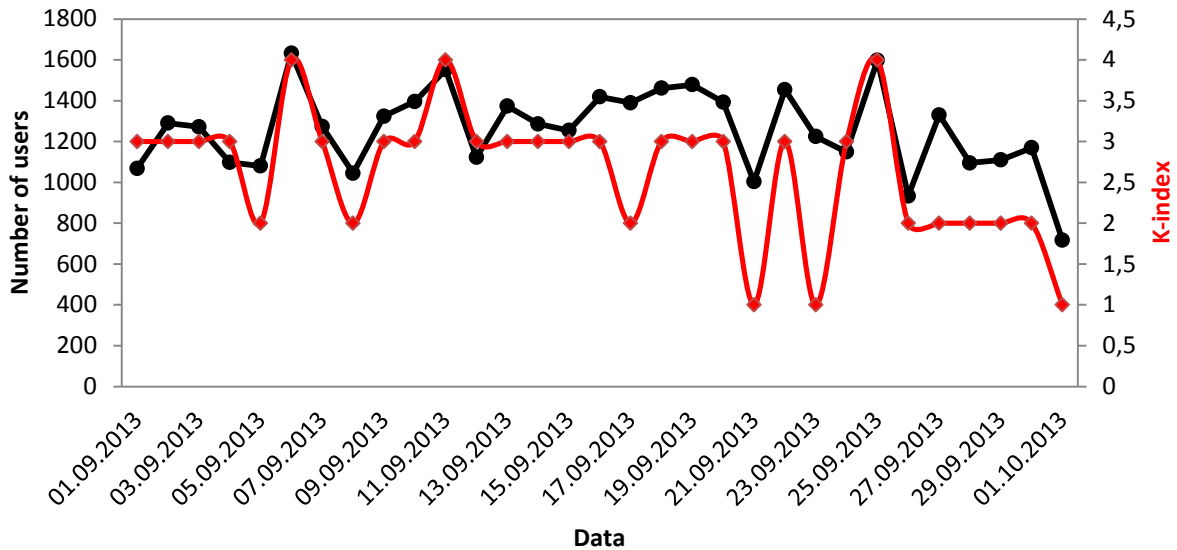


Figure 1. The dependence of «2GETHER» site attendance and K-index on time

This conclusion is also supported by results obtained from the data presented in figure 2 (The dependence of the load of Beeline mobile network operator on time). Calculation of the coefficient of correlation between the function and K-index of magnetic field gives a value of  $r= 0.82$  for the period from August 19 to November 14, 2013.

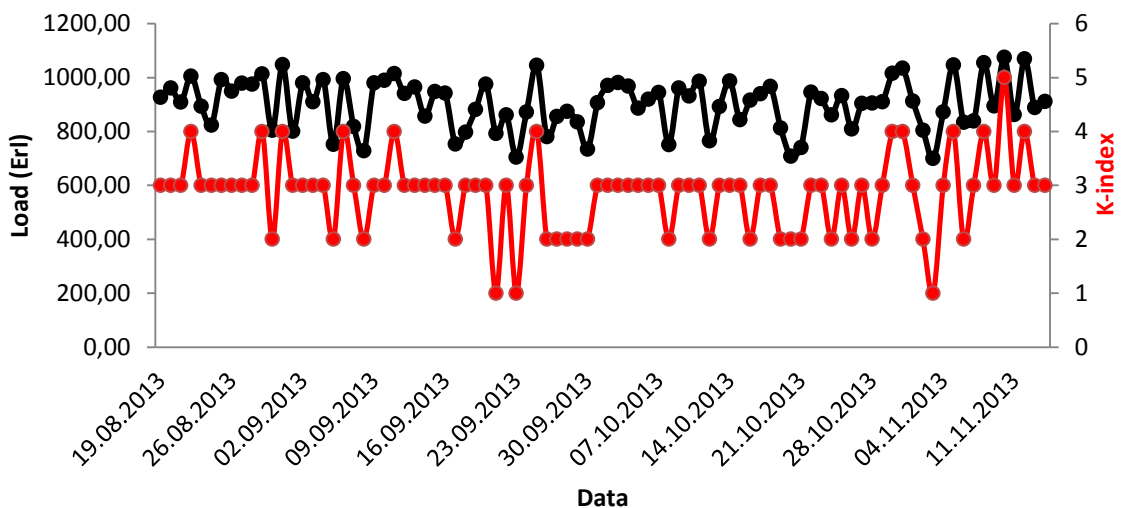


Figure 2. The dependence of the load of Beeline mobile network operator and K-index on time (data on Almaty city)

On the basis of this and a number of other similar examples we can conclude that the reaction of the user, expressed through the communication activities in the telephone

network, is much more pronounced than through site attendance. This result is quite logical, as currently the user has a twenty-four-hour access to the phone in contrast to the Internet.

On the basis of these data it can be assumed that the individual peculiarities of the individual’s reaction to variations of the parameters, characterizing the state of the space weather can be determined on the basis of the analysis of correlations between, for example, the frequency of telephone conversations of a specific subscriber and such parameters as K-index.

Figure 3 presents the dependence, reflecting the communication activity of a certain testee person «A». In this graph, the horizontal axis is divided into 6-hour intervals. The ordinates axis shows the number of outgoing calls of that particular subscriber, falling to the specified time interval. (Incoming calls were not counted, since they reflect mainly communication activities of other subscribers.)

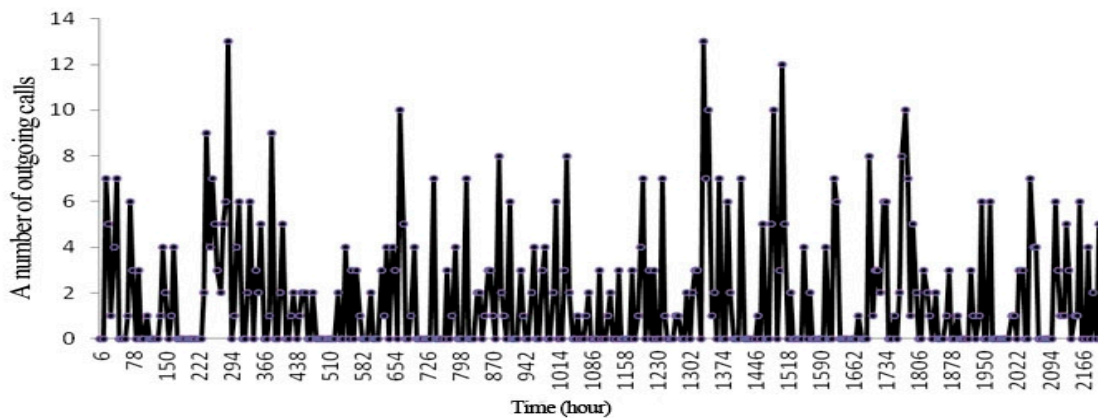


Figure 3. The dependence of a certain subscriber’s communicative activity on time

The coefficient of correlation between K-index and the communication activity of «A» subscriber amounted to 0,59 when calculating the correlations using per-second precision of the time of the incoming call. The value of this indicator for the case when the time of the call was rounded to minute, also reached 0,59 within the accuracy of rounding. When using the data format when the time of outgoing calls have been rounded to 0.1 hours, the index value was 0,58. Looking ahead, it should be noted that, the economy of information volume, specified by the accuracy of rounding is essential.

Similar figures were obtained on the basis of a survey of 8 other subscribers. These data are presented in Table 1 for different nature of time rounding.

Table 1. The distribution of the correlation coefficient between the communication activity of a certain subscriber and K-index of geomagnetic field (certain testees are marked with separate letters of the Latin alphabet).

Testee	A	B	C	D	E	F	G	H
Correlation coefficient (precision in second)	0,59	0,87	0,91	0,74	0,81	0,57	0,90	0,71
Correlation coefficient (precision in minute)	0,59	0,88	0,91	0,73	0,82	0,57	0,90	0,71
Correlation coefficient (precision in 0,1 hour)	0,58	0,88	0,92	0,73	0,83	0,57	0,92	0,70

Apparently, the values obtained are characterized, as expected on the basis of literature data [1-6], by a significant dispersion. It can be argued that, just as there are meteo-

dependent people, so there are people with pronounced reaction to variations in the geomagnetic situation.

The detection of these reactions is the content of services, which, as noted above, is able to expand the range of services provided by means of modern means of mobile communication. The purpose of such services is informing the subscribers on the existence or absence of reaction on space weather variations (obviously, on the basis of information about the nature of communication activity and data received by the monitoring centres for space weather a more comprehensive survey can be conducted, involving other values characterizing the state of the space weather). In addition, the service can be included the announcement of subscribers on the periods of their heightened physiological reaction to external stimuli, in accordance with [1].

It must be emphasized that the provision of these services to subscribers is effectively implemented using the resources, already available to mobile operators. However, this approach faces a number of difficulties of legal and organizational nature.

Therefore in the frame of this work an alternative option was developed, that is based on the use of new keyboards designed for complementing *mobile phones*. Keyboard with optical encoding is being actively developed in Kazakhstan at the present time [7], however, the principle of their action doesn't play an important role for the purposes of this work.

It is important to emphasize that the use of this keyboard has a number of consumer benefits (in particular, such keyboard can be made folding, with the folded keyboard having a size smaller than the size of the cell phone). In addition, the work of this keyboard is supported by its own software installed on the cell phone.

Accordingly, there is a possibility to combine the software with additional functions. One of them is the implementation of the diagnosis of psycho-physiological reactions of the individual to space weather variations. This approach lets provide cell phone users with a considered service in manner independent from mobile operators.

Implementation of an approach resolves itself into ensuring the following additional functions with the software specified above:

- collecting information on time and duration of outgoing telephone calls;
- transferring information collected into the data center on condition that the subscriber processes a subscription to the corresponding service.

It is essential that these additional functions slightly complicate the software.

Moreover, this work offers the original expansion of the diagnostic capabilities of the system. Namely, according to the preliminary data the psycho-emotional and psychophysiological state of a person is also reflected in the nature of typing and the messaging pace, etc. All these parameters can be used directly for medical diagnostic purpose, that justifies the use of the extended platform, which collects information about cooperation between «user - mobile communicator». It is also significant that for the promotion of the proposed approach it is sufficient to initially confine oneself with one service. The introduction of other services of this kind can be made on a subscription by an updating method.

Organizationally, the operation of cosmic- weather diagnostic center is based on the exchange of SMS-messages between the centre and the users. It is therefore quite important to reduce the number of characters that are sent from a mobile phone of the user to data center. With the standard length of an SMS message comprising 160 Latin or 70 Cyrillic symbols and the usage of rugged format with the precision in 0,1 hour, not containing floating comma (for example, passing a set of characters 134 instead of 13.4) this message comprises an information on approximately 150 telephone calls (more precisely, about the time when 150 telephone calls were made).

Thus, supporting costs on system maintenance are relatively small even in a fully independent mode (1-3 outgoing calls from the subscriber SMS messages + 1 message from the centre). Under the existing cost of services in Almaty it amounts to 15 tenge (\$ 0,1).

Accordingly, the cost of services is low either, on average, 75 tenge (\$0,5) per day and affordable for the majority of users of mobile communication networks, at least in Almaty.

Further reduction of the cost of the service requires either the organization of interaction with cellular communication operators or connection of the service data transmission via personal computers. The latter requires only some modifications of the software, but will not affect the quality of service provided, as the collection of diagnostic information can be delayed to 1-3 days.

## **Conclusion**

The work shows that the diagnosis of psycho-emotional and psychophysiological condition of an individual reacting to space weather variation can be traced on the basis of a monitoring of the communication activity of subscribers of mobile communication networks.

Conduct of such diagnosis composes the content of new SMS-services that can be provided to the users both in an interaction mode with mobile network operators, and in operation mode of independent diagnostic centers.

The estimation of the service value indicators shows that it is available for the vast majority of mobile phone users, and there are considerable reserves for further cost reduction. Besides, such a system gives possibility for development of new methods of diagnostics of noosphere as whole, which will be able to give experimental basis for such conceptions as [8-10].

## **References:**

- Vladimirsky, B. M. Temuryants, N.A. (2000) Influence of solar activity to biosphere - noosphere (Heliobiology from A.L.Chizhevsky to our days). Moscow: IIUEPS publishing house, p.254.
- William, P. F. (1947) Man, Weather, Sun. Illinois: Springfield, Charles C. Thomas Publisher, p.457.
- Davis, G.E., Lowell, W.E. (2006) Solar cycles and their relationship to human disease and adaptability. *Med Hypotheses*, 67( 3), p. 447-461.
- Birzele, R. (1966) Sonneactivitat und Biorhythmus des Venchen: Neuer in typologischen Experimenten erzielter Paralletitat snachweis. Wien: F.Deuticke Derlog, p.246.
- Odintsov, V. I., & Zaitzev, A. N. (2001) Near-Earth effects of the interplanetary magnetic field. XXVI EGS General Assembly, Geophysical Research Abstracts, p.6893.
- Stoupel, E.( 2002) The effect of geomagnetic activity on cardiovascular parameters . *Biomed Pharmacother*, 56(2), p. 247-256.
- Suleimenov, I. E., Mun, G., Ivlev, R., Panchenko, S., & Kaldybekov D.( 2012) Autooscillations in Thermo-responsive Polymer Solutions as the Basis for a New Type of Sensor Panels. *AASRI Procedia*, 3, p. 577-582.
- Suleymenova, K.I., Shaltykova, D.B., & Suleimenov, I.E. (2013) Aromorphoses phenomenon in the development of culture: a view from the standpoint of neural net theory of complex systems evolution. *European Scientific Journal*, 9(19), p.68-74.
- Mun, G. A., Negim, E. M., Shaltykova, D. B., Park, I. T., & Suleymenov, I. E. (2013) The Irrational: A View from the Standpoint of Noospherology. *World Applied Sciences Journal*, 22(10), p. 1420-1425.
- Suleimenov, I E. and Panchenko, S. (2013) Non-Darwinists Scenarios of Evolution of Complicated Systems and Natural Neural Networks Based on Partly Dissociated Macromolecules. *World Applied Sciences Journal*, 24(9), p.1141-1147.