LARGE-SCALE BIOPHYSICAL EXPERIMENT "GELIOMED-2"

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ABSTRACT. Results and new design of large-scale biophysical experiment "Geliomed 2" discusses.

Key words: Solar-terrestrial relations, magnetic storms, monitoring, Chizhevsky-Velhover effect, metachromasia

As we reported earlier, the project "Geliomed" was started by a group of Russian and Ukrainian researchers in 2006, the year as a proactive and dedicated to the study of the impact of space weather on biological systems [1]. In the period from 2006 to 2010 have been successfully carried a series of synchronous monitoring, new experiments on the measurement of the same type equipment ECG signal 1st diversion that centrally processed using an original technique [2].

Data already conducted monitoring studies that were performed synchronously in Yakutsk (Samsonov SN), Troick (Ragulskaya MV), Simferopol (Grigoriev PE) and Saratov (Rogacheva SM) revealed several specific especially the effect of external factors on the human body and to develop an algorithm of automatic detection of group effects.

The existence of several fixed universal individual programs for adaptation to Cosmo and geophysical factors proved. The peculiarities of individual heliobiological reactions depending on the season and the phase of the cycle of solar activity on the basis of data at nearly the full period of solar activity proved. We prove the existence of group and population effects. Questions of nonlinear dynamics and stability of biosystems to periodic external force and parametric noise considered with the help of a new theoretical model.

In 2010, the authors extended the telecommunications large monitoring experiment "Geliomed" released book "Biotropic impact of space weather", which sets out the main results of the project [3].

In 2014, a new joint Russian-Ukrainian project "Role of normal and extreme heliogeophysical processes in the evolution of the biosphere" started. The project aims to study the dynamic co-evolution of the Sun and the biosphere in terms of early and modern sun and consists of two blocks of research: theoretical (the study of modern solar-terrestrial relationships and processes in the heliosphere epoch of formation and development of the early biosphere) and experimental (based on modern biological systems and databases Information about the dynamics of the factors cosmogeophysical 23-24 solar activity cycle). The experimental part of project is based on block-oriented technology internet portal "Geliomed» (http://geliomed.immsp.kiev.ua) and therefore we have named "Geliomed-2."

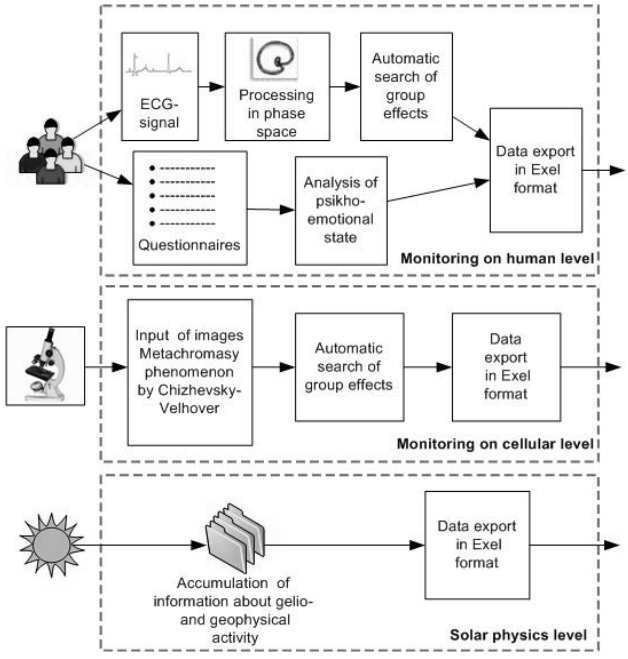

Figure 1: Design of experiment "Geliomed 2"

The overall design of the experiment Geliomed-2 is clear from Figure 1. The technique of monitoring experiments at the level of assessment of people using Internet-based portal technologies in the project "Geliomed-2" are complemented by monitoring at the cellular level for the reference cell culture Accharomyces cerevisiae.

It is known that for a given cell culture Ukrainian microbiologists perfected and adapted method of estimating the metahromasia effect of volyutin grains, known in the literature as "planetary Chizhevsky-Velhover effect" [4].

In our project, we plan to standardize the technique of coloring volyutin grains of yeast Saccharomyces cerevisiae and complete development of automated methods for quantifying this reaction.

Visual readout of the reaction in the study of metachromasia Chizhevsky-Velhover effect is formulated as:"change of color volutin grains from blue to red through purple". It is clear that for "immersion" in this study project "Geliomed" it was necessary to formalize a procedure for evaluating the effects of metachromasia terms of analysis of digital images.

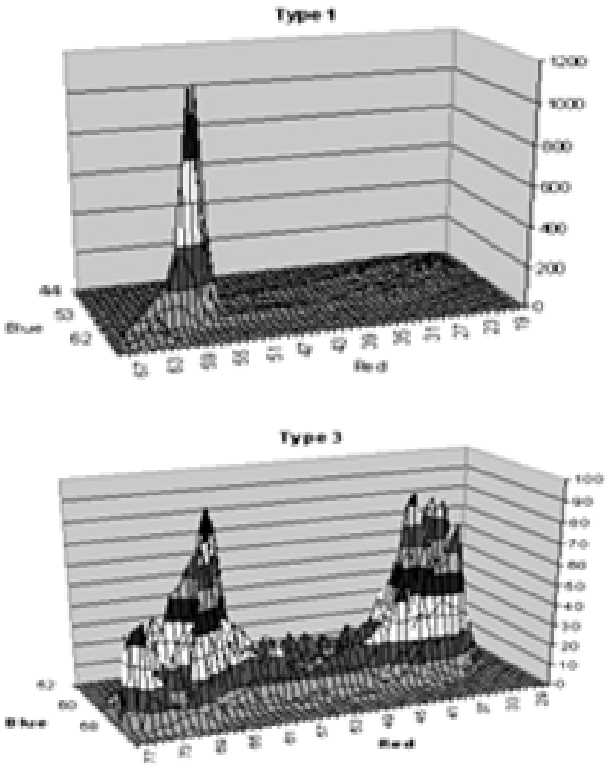

Figure 2: Histograms for two states volutin grains

The first experiments with the "dissection" of digital images of volyutin granules of Saccharomyces cerevisiae yeast cells UKM-517 yielded new information understanding of the phenomenon metachromasia and possible to formulate a number of issues and hypotheses.

The figure 2 Up shows the typical histogram of pixels in the grain volutin red-blue plane RGB-image model for the phenomenon of lack of metachromasia. On the Down figure 2 – similar histogram for the most obvious manifestation of metachromasia volutin grain. It is evident that the phenomenon of metachromasia is the presence of two stable states volutin grain, which resembles a phase transition.

Automated estimation algorithm metachromasia reaction is based on results of statistical processing of such histograms for daily studies metachromasia effect. Currently specified thresholds for images that experts refer to a state of "no effect metachromasy, Type 1" and "on-metachromatic effect is observed, Type 3".

The resulting long rows biotropic effects at different levels of organization of the biosphere will be used to develop new synthetic indexes of space weather, which could well reflect actual biotropic effects caused by the Helios factors.

Acknowledgements. The project is supported by the RFFR grant 14-02-90424-Ukr_f_a and NASU grant 36-02-14.

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