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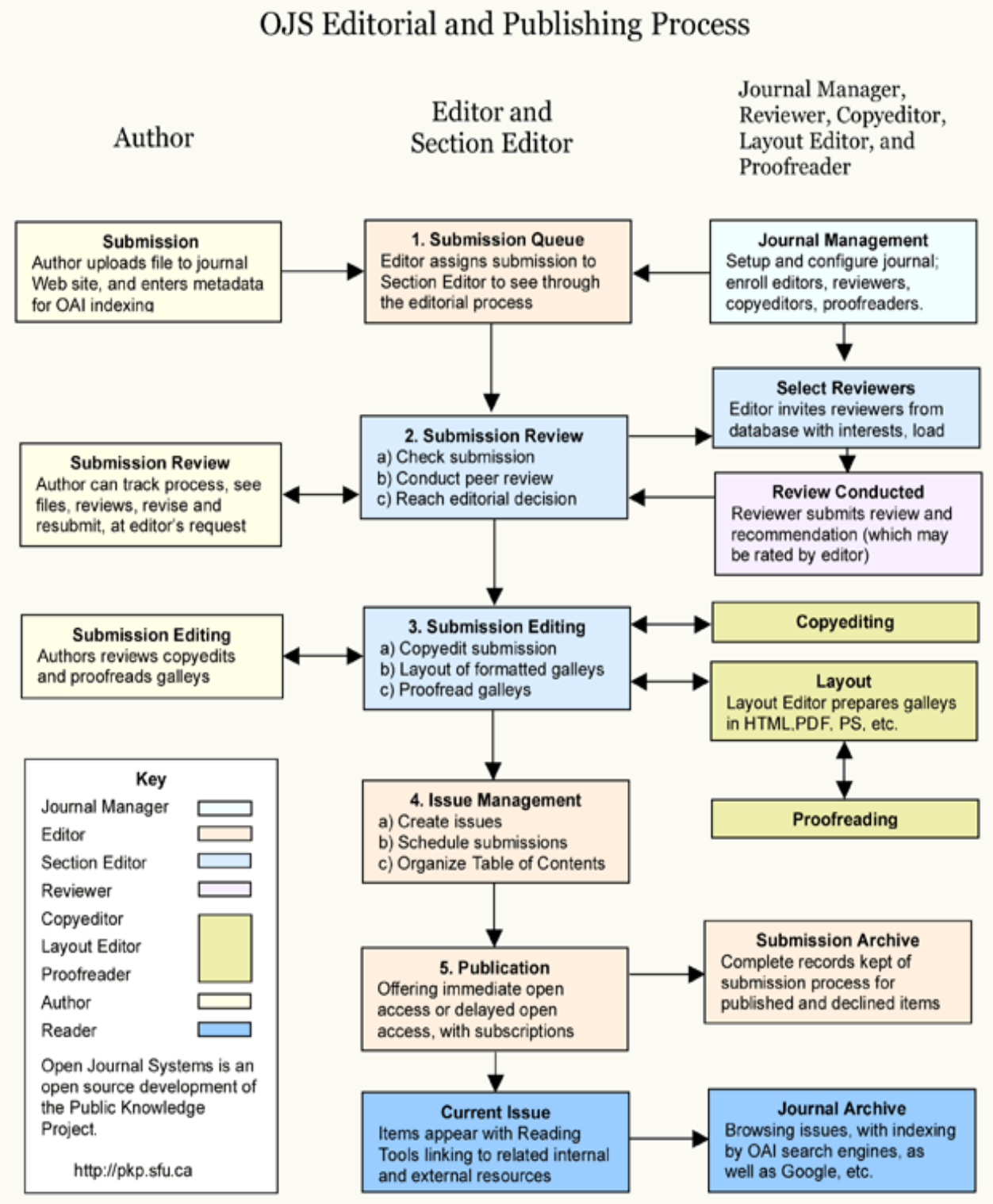

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Acoustics in Geophysics and Geomechanics

[1]Nodar D. Varamashvili, [1]Tamaz L. Chelidze, [1]Zurab T. Chelidze, [2]Malkhaz G. Gigiberia, [1]Nugzar I. Ghlonti

[1]M. Nodia Institute of Geophysics of I. Javakhishvili Tbilisi State University
[2]Ilia State University, Tbilisi, Georgia

ABSTRACT

Acoustic radiation can be initiated during various processes (landslides, mudslides, avalanches, ...). By recording and analyzing the acoustic waves that have arisen in the process of various processes, one can make important conclusions about events of interest to us. Passive and often active methods can be used to study the environment, buildings, living organisms, without damaging them. The paper presents experiments of laboratory modeling arising of acoustic impulses during landslide processes and their results. In paper is reviewed possibility using acoustic methods for monitoring and predicting landslide processes. This method allows you to create landslide monitoring and early private systems with low costs. The paper also presents the results of the study of the mechanical properties of walls of two ancient church and the degree of they damage by measurement of velocity of ultrasound waves, and tomography methods.

***Key words*:** acoustic, landslide, Lamb waves, P-wave, S-wave, tomography

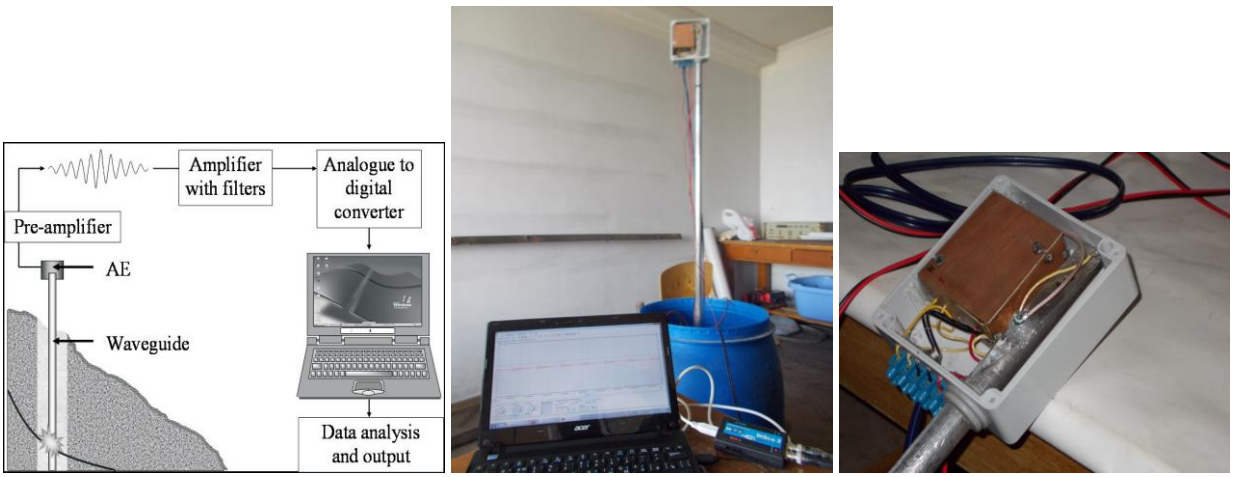
Introduction

Acoustic methods are a very powerful tool in geophysical search, engineering and medical research. Acoustic waves in the seas and oceans can transmit and receive information over long distances, with little loss [5]. In our scientific research we use acoustics in several areas. In this paper we present scientific-applied researches in the fields of geodynamics and geomechanics using acoustic methods [1].

Acoustic in geodynamics

Traditionally, landslides can occur on very steep slopes in mountainous regions, such as Georgia, which do not accurately reflect the nature of this problem. Landslides can occur virtually anywhere in the world. The mountainous regions are, of course, in greater danger. Studies have been conducted for decades to monitor soil movement using acoustic emission (EE).

Detecting AE generated by a developing shear surface within a slope is not an easy task. As AE propagates through soil, it suffers from a loss of signal amplitude: attenuation is high in soil because it is a particulate (granular) medium and energy is lost as AE travels across boundaries from one particle to another. The use of a waveguide to provide a path of low attenuation from the source of the AE (within a soil slope) to the sensor (usually situated above ground surface) has become a standard practice in AE research [1,3,4]. The presence of a waveguide, typically a metal pipe inserted within an unstable slope, also greatly increases the monitoring ability of the AE sensor.



a. b. c.

Fig.1. (a) components of acoustic monitoring system (Dixon et al., 2003), (b) Landslide creep modeling and associated acoustic emission recording using USB oscilloscope and (c) acoustic sensor

Figure 2 shows a schematic representation of a typical AE instrumentation system. AE originating from the deformation of a backfill within the active waveguide propagates along a steel waveguide to a piezoelectric sensor secured to the top of the metal waveguide [2]. The AE signal is then amplified by a preamplifier and an amplifier to enable the signal to travel down the lengths of cable without being subsequently affected by background or electrical noise. Finally the AE is converted to a digital signal for subsequent analysis and manipulation using real time data acquisition software.

The goal of our study is registration and monitoring of landslide slow motion (creep) by recording the acoustic emission. For this goal we developed the special equipment (Fig.3). Plastic barrel is filled with a soil from the landslide, the in the center of which is a cylinder filled with small stones. The cylinder diameter is approximately 15 cm and a mean diameter of stones about 7 mm. In the center of gravel parcel thick-wall stainless steel tube is placed, through which acoustic pulses arisen in the gravel are transmitted to the acoustic sensor. The deformation of the experimental set up is done with the help of a mechanical jack [3,4].

The similar technique based on the recording of the acoustics generated by displacement in the gravel coating around acoustic sensor was earlier developed by Loughborough University team, but it demands drilling of relatively deep borehole down to the sliding surface. This procedure is quite expensive. Our objective was to develop a cost-effective version of the mentioned method. The idea is to use two sensitive acoustic probes grounded on different depths, one on the depth of several meters and other close to the day surface. The former probe is the basic and the role of latter one is to distinguish signals of surface origin, which in this case are considered as noise.

Registration of acoustic pulses occurring at small shifting of the landslide soil was produced by the acoustic sensor, which was attached to the USB oscilloscope (Fig.1), with which after using special processing software information is sent to computer [3].

Acoustic in geomechanical problems

As approved in the world geophysical community, geophysical methods are increasingly used to solve various engineering and household tasks, to evaluate and investigate the condition of buildings and their infrastructure and to perform restoration work purposefully.

Acoustic (ultrasound) methods are widely used to study the mechanical parameters structures and buildings from stone, wood, reinforced concrete, metal. With ultrasound equipment, without damaging structures and buildings, it is possible to locate and assess the voids, cracks in them and the degree of their damage.

We used ultrasonic equipment from the Swiss company (PROCEQ, https://www.proceq.com/) to perform geophysical work, which is called Pundit PL-200 and Pundit PL-200PE.

Fig.2. PUNDIT PL-200 and PL-200PE Ultrasonic flaw detector

Импульсный эхо тестер (Pulse Echo Transducer) - Pundit PL-200PE

With the help of a pulse tester it is possible to conduct several types of testing (Scanning):

B-Scan

Cross section of the scanned surface. Useful when searching for pipes, cracks, voids, etc.

A-Scan

Gives the possibility of direct signal analysis. It has automatic thickness reading (echo tracker).

Area Scan

Values of the velocity or thickness of the object under study, in the form of a contour map.

The **Pundit PL-200** Ultrasonic Tester gives us oportunity to investigate, follow to three ways, introduced below:

Direct transmission: optimal configuration with a maximum signal amplitude. The most accurate method for determining the speed of a pulse

Indirect Transmission: The signal amplitude is approximately 3% of the amplitude of the direct transmission signal.

Sideways (semidirect) transmission: sensitivity is somewhere between the first two methods. The distance is measured from the center to the center.

One of our goals was to study the actual situation of the Churchs of Satxe and of Tiseli (Georgia) using the ultrasonic device of the Pundit firm PROSEQ (Fig. 3).

a. b.

Fig.3. a. Works in Satxe Church b. Works in Tiseli Church

The following types of observations was conducted at various sites of church, based on the capabilities of the ultrasound device:

On the walls of the buildings, sites were selected where the mechanical properties of the stones and mortar were studied. In addition, on the south pillar of the main temple and also on the adjacent wall, through the device, a cross-section of profiles was taked 0.1m apart. Since the P and S elastic wave velocities are theoretically and empirically linked to the wall condition parameters, in we may consider the presence of weakened, depleted, and relatively disturbed zones within the study area. Using P and S waves sensors on the visually stored and attenuated areas of the walls of the building resulted in:

With our sensors, we get a good effect at about 0.4 m base (distance between reflector and receiver). It depends on the condition of the stone and the mortar.

The obtained materials determined the propagation velocities of P and S elastic waves, both in the basalt and tuff stone blocks, as well as in the blocks and their filling mortars. On the basis of these velocities the physical-mechanical parameters were determined:

ρ - density; ν-Poisson coefficient; E - Young's dynamic module;

G - shear module; K - compression module;

Based on the results of the work, were carryed out analysis about condition of the Tiseli Church walls rocks, certain areas and exposed areas of the mortar and also were a comprehensive report could be a guide for specialists to undertake future restoration or conservation work.

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რეზიუმე

სხვადასხვა პროცესების (მეწყერი, ღვარცოფი, ზვავი,...) მიმდინარეობისას შეიძლება მოხდეს აკუსტიკური გამოსხივების ინიცირება. აღძრული აკუსტიკური ტალღების რეგისტრაციით და ანალიზის საშუალებით შესაძლებელია ჩვენთვის საინტერესო მოვლენებზე მნიშვნელოვანი დასკვნების გაკეთება. პასიური და ხშირ შემთხვევაში აქტიური მეთოდებით შესაძლებელია გარემოს, შენობა-ნაგებობების, ცოცხალი ორგანიზმების გამოკვლევა მათი დაზიანების გარეშე. ნაშრომში წარმოდგენილია მეწყრული პროცესების მიმდინარეობისას აკუსტიკური იმპულსების აღძვრის ლაბორატორიული მოდელირების ექსპერიმენტები და მისი შედეგები. განხილულია აკუსტიკური მეთოდების გამოყენების შესაძლებლობა მეწყრული პროცესების მონიტორინგისა და პროგნოზისათვის. ეს მეთოდი საშუალებას იძლევა მცირე დანახარჯებით შეიქმნას მეწყრის მონიტორინგისა და ადრეული შეტყობინების სისტემა. ნაშრომში ასევე წარმოდგენილია, ულტრაბგერითი გაშუქების, დრეკადი ტალღების სიჩქარეების გაზომვის და ტომოგრაფიის მეთოდებით, რამდენიმე ეკლესიის კედლების მექანიკური მახასიათებლების, დაზიანების ხარისხის შესწავლის შედეგები.

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Н.Д. Варамашвили, Т.Л. Челидзе, З.Т. Челидзе, М.Г. Гигиберия, Н.Я. Глонти

Резюме

Акустическое излучение может инициироваться во время различных процессов (оползни, сели, лавины, ...). Записывая и анализируя акустические волны, возникшие в процессе различных процессов, можно сделать важные выводы о событиях, которые нас интересуют. Пассивные и часто активные методы могут быть использованы для изучения окружающей среды, зданий, живых организмов, не повреждая их. В статье представлены эксперименты лабораторного моделирования возникновения акустических импульсов при оползневых процессах и их результаты. В статье рассматривается возможность использования акустических методов для мониторинга и прогнозирования оползневых процессов. Этот метод позволяет, низкими затратами, создавать экономичные системы мониторинга и раннего оповещения опользневых процессов. В работе также представлены результаты изучения механических свойств стен двух древних храмов и степени их повреждения путем измерения скорости ультразвуковых волн, а также методами ультразвуковой томографии.

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Water Search and Landslides Study Using Electroprospecting

[1]Nodar D. Varamashvili, [1]Dimitri V. Tefnadze, [1]Dimitri Z. Amilaxvari, [1]Levan B. Dvali, [1]Tornike G. Chikadze, [1]George T. Qajaia, [2]Davit N. Varamashvili

[1]M. Nodia Institute of Geophysics of I. Javakhishvili Tbilisi State University
[2]Georgian Technical University, Tbilisi, Georgia

ABSTRACT

Electrical exploration is a large group of geophysical methods that study electromagnetic fields of various nature. The purpose of these studies is to determine the electromagnetic characteristics of the geological environment (resistance, conductivity, polarizability, etc.), knowing which you can get valuable information about the structure of the studied area or region. By the type of electromagnetic fields, electrical exploration can be divided into two groups: the first - combines methods that study natural, the second - artificial electromagnetic fields. The first ones are called natural electric fields methods, and the other - methods of resistance. The materials presented in our work have been obtained with resistance (vertical electric sounding) method. The article provides a brief overview of the results of various types of work. Studies results on the possible moisture of rocks and the existence of groundwater at different depths are presented. Also presented are the results of lithology of rocks in landslide zones, studies of the possible moisture and evaluation of landslide safety coefficient (FS) for several landslides.

Key words: Vertical Electrical Sounding, Resistivity, Groundwater, Landslide

Introduction

In electroprospecting (resistance method) is used artificial power source. The electricity reaches the ground through the power electrodes and the difference between the arised potentials is measured by the receiving electrodes on the earth surface. If the environment is homogeneous, the resistance method gives us true conductivity, which will not depend on the configuration of electrodes and the position of electrodes on the surface of the earth, since the true conductivity is a constant. In electric resistivity imaging (ERI) electric currents are injected into the ground and the resulting potential differences are measured at the surface, yielding information about the distribution of electrical resistivity below the surface. Finally this gives an indication of the lithological and structural variation of the subsoil (since resistivity depends on sediment porosity and pore water). In the shallow subsurface, the presence of water controls much of the conductivity variation. Measurement of resistivity is, in general, a measure of water saturation and connectivity of pore space. This is because water has a low resistivity and electric current will follow the path of least resistance. Increasing saturation, increasing salinity of the underground water, increasing porosity of rock (water-filled voids) and increasing number of fractures (water-filled) all tend to *decrease* measured resistivity. Increasing compaction of soils or rock units will expel water and effectively increase resistivity.

In environment ΔV, and therefore impedance ρ should be dependent on the configuration and location of electrodes, as secondary fields influence on the primary field [2]. Therefore, the measured ρ value in nonhomogenous environments is called an apparent resistivity and is signed as ρ_a. The coefficient of reaccount for uneven environment depends on the configuration of electrodes. Different configurations of the electrodes are used according to the type of problem. In our tasks we used the Schumerberger method. Receiver MN electrodes are fixed in the center of the device, while the distance between the current AB electrodes increases gradually [3].

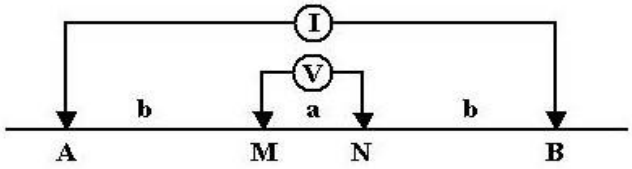

Fig.1. Schlumberger method of vertical electrical sounding

The vertical electrical sounding (VES) method relies on the fact that the greater is the distance between of current electrodes (AB), deeper penetrating the current, than from more deep layers we receivs information by measured potential on the electrode.

Electrical resistance table for some of the rocks

The name of the rock	Electrical resistivity (Ohm/m)		
	min	typical	max
Clay	5	10	15
Loam	10	30	50
Sand clay	30	50	80
Water-saturated sands	50	80	200
Sands slightly moist	100	150	500
Dry sands	200	500	10000
Carbonate rocks weakly cracked	500	1000	5000
Intrusive rocks weakly fractured	1000	2000	10000
Bulk	30	50	500
Permafrost rocks of various ice content	500		80000
Ores minerals conductors(in mostly sulphides)	0.001		1-5

As we see from this table [2], the electrical resistance is different for different rocks that allow us to be more confident about the definition of rocks, the water content in them, and to overcome various geophysical tasks.

Search for water

We carried out one of the interesting works through vertical electric sounding for water searching in Sachkhere district, in the valley village of Savane, in the vicinity of the river Kvirila. The works were carried out by the Italian electrometer equipment (Earth Resistivity Meter PASI 16GL-N).

In the search range, up and down to the Kvirila River, several electrical survey profiles were conducted. The measurements were carried out at several points on each profile using the method of vertical electrical sounding. In total, 26 points of vertical electrical sounding (Schlumberger methods) on the left bank of the Kvirila River, north of the village of Savane. The length of each spreading was 500 meters and a depth of about 170 m.

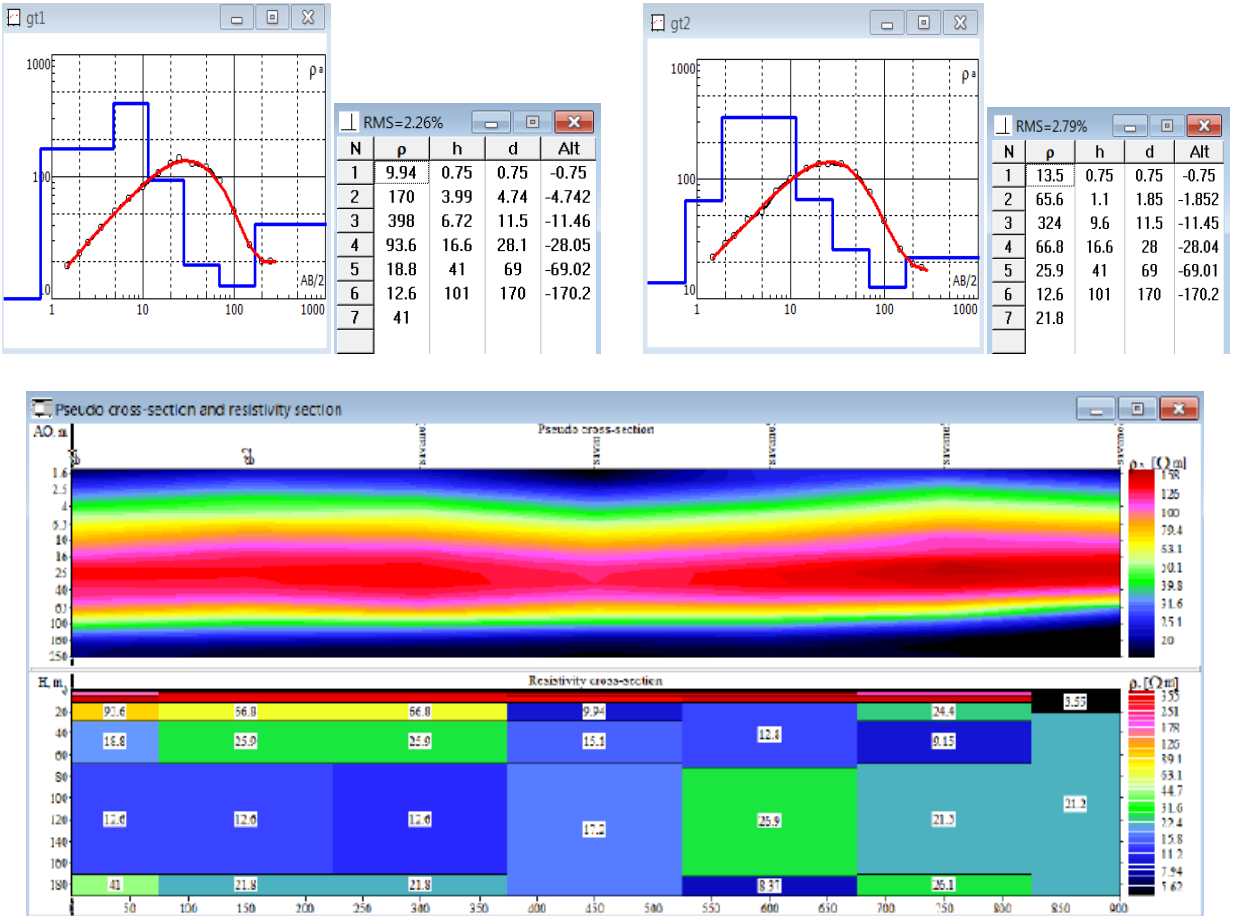

Fig 2. Vertical electric sounding in two different points with appropriate resistance and separated layers and one of the long resistivity profile

Figure 2 shows that in both cases VES-a stands out wet layers, relatively dry layers, clay, loam, which is quite good matches with the actual results of drilling. It also presented a long profile (about 1200 meters) obtained by joining several small profiles on one line. Several such profiles were made along the Kvirila River.

Assessment of landslide hazard

Complex geophysical studies were conducted on the Khoko landslide at the Enguri reservoir. We took part in the works with electro prospecting equipment (Earth Resistivity Meter 16GL-N). On the Figure 3, presented the process carrying of the above works and the results of the vertical electrical sounding, in one point, measured by three electrode method. The graph shows that with increasing of the depth is reduced by the imaginary resistivity, grows the moisture layers. The obtained results allow us to conclude that landslide processes are developing in the local area. The thickness of the layers in the process is not large (about 5-10 meters). The process is activated periodically during the rainy season.

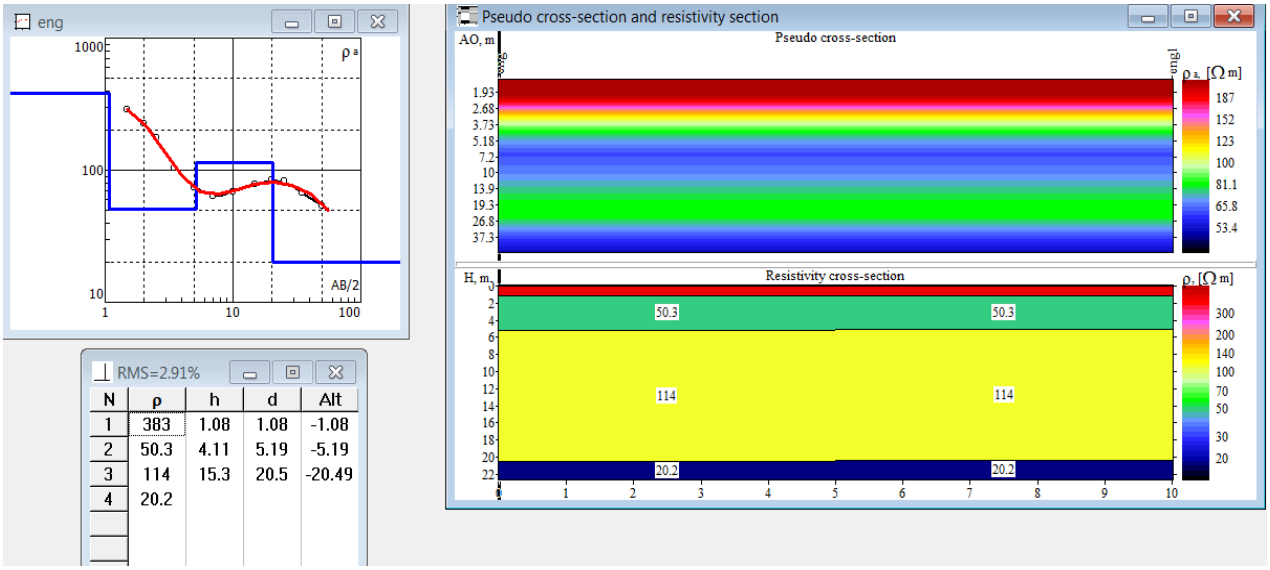

Fig.3. Carrying works on the Khoko landslide and the results of vertical electric sounding measured by three electrode method in one point of the landslide

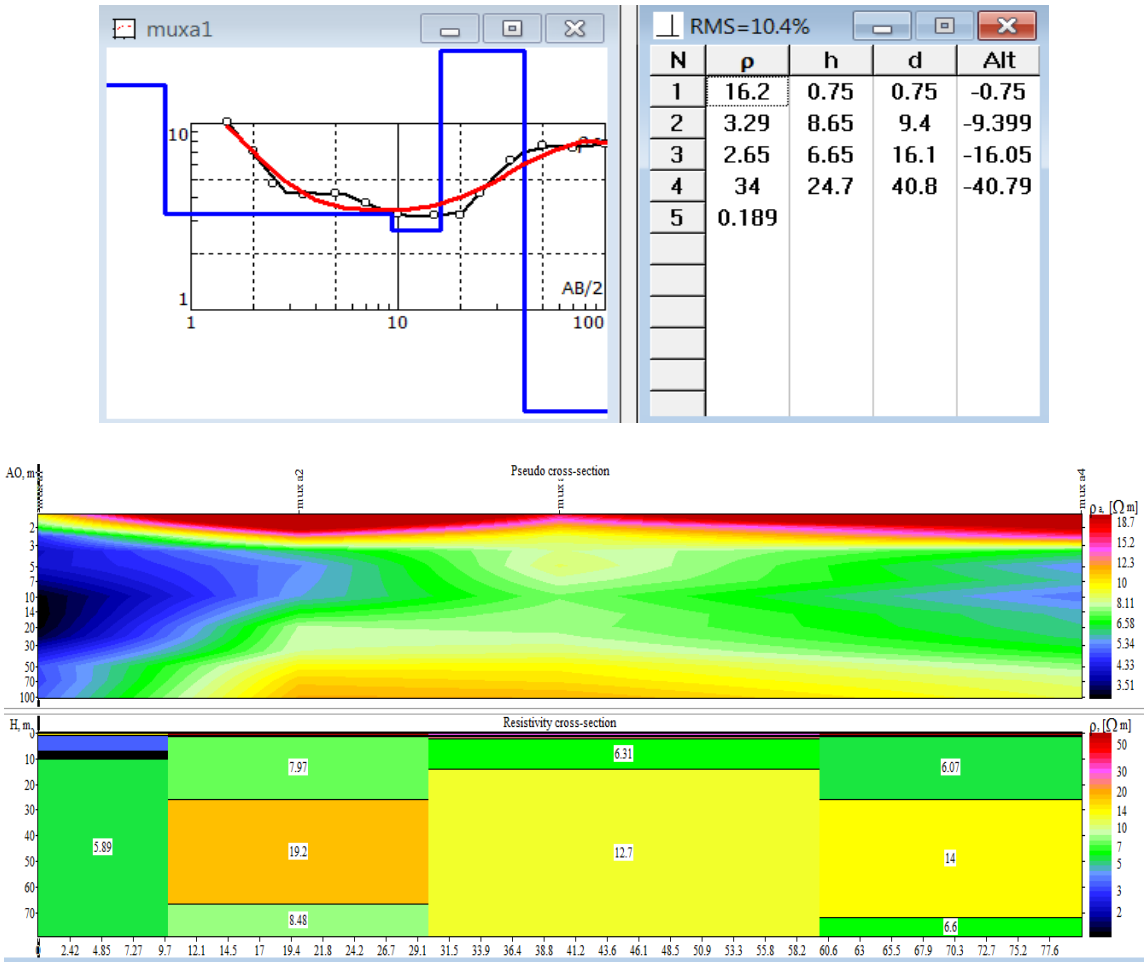

Fig.4. Results of vertical electrical sounding on Mukhatgverdi landslide

Works were also carried out on the Gombori landslide. On the above-mentioned landslide was made of vertical electrical sounding by Schlumberge's method. Were conducted assessment of the risk factor of the landslide .

In order to assess the risk of landslide, exist a factor of safety [4]:

$$FS = \frac{c + hgcos^2\theta(\rho_r - \rho_w m)\tan\phi}{\rho_r hg \sin\theta \cos\theta}$$

Where c is the cohesion, h - the thickness of the potential sliding mass, g - acceleration of free fall, θ surface slope angle, ρ_r - density of landslide rocks , ρ_w - water density, m - moisture layer part in the sliding layer, ϕ - internal friction angle.

When FS> 1 → landslide is stable, FS <1 → landslide is unstable, FS = 1 → The condition of the landslide is critical.

We also conducted electroprospecting works on one of the landslides near Mukhatgverdi road, which potentially threatens the road to Mukhatgverdi cemetery.

Mukhatgverdi landslide consists of several blocks, some of which are active (moving) and some are stable (immovable). We took measurements on all moving and immovable blocks.

The obtained results show unstable conditions in case of large rainfall (as well as in case of earthquake) and relatively stable conditions in dry period.

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წყლის ძიება და მეწყრების შესწავლა ელექტროძიების გამოყენებით

ნ. ვარამაშვილი, დ. ტეფნაძე, დ. ამილახვარი, ლ. დვალი, თ. ჭიკაძე, გ. ქაჯაია, დ. ვარამაშვილი

რეზიუმე

ელექტროძიება არის გეოფიზიკური მეთოდების მიმართულება, რომელიც სწავლობს სხვადასხვა ბუნების ელექტრომაგნიტურ ველებს. ამ კვლევების მიზანია გეოლოგიური გარემოს ელექტრომაგნიტური მახასიათებლების დადგენა (წინააღმდეგობა, გამტარობა, პოლარიზაცია და ა.შ.), რომლითაც შეგიძლიათ მივიღოთ ღირებული ინფორმაცია შესწავლილი ტერიტორიის ან რეგიონის აგებულების შესახებ. ელექტრომაგნიტური ველების ტიპის მიხედვით, ელექტრული გამოკვლევა შეიძლება დაიყოს ორ ჯგუფად: პირველი - აერთიანებს მეთოდებს, რომლებიც სწავლობენ ბუნებრივ, მეორე - ხელოვნურ ელექტრომაგნიტურ ველებს. პირველ მათგანს ბუნებრივი ელექტრული ველის (ბევ) მეთოდებს უწოდებენ, ხოლო მეორეს -წინააღმდეგობის მეთოდებს. ჩვენს ნაშრომში წარმოდგენილი მასალები მიღებულია წინააღმდეგობის (ვერტიკალური ელექტრული ზონდირების) მეთოდით. სტატიაში წარმოდგენილია სხვადასხვა ტიპის სამუშაოების შედეგების მოკლე მიმოხილვა. წარმოდგენილია ქანების გაწყლიანების და მიწისქვეშა წყლების შესაძლო არსებობის კვლევა სხვადასხვა სიღრმეებზე. ასევე მოყვანილია მეწყრულ ზონებში ქანების ლითოლოგიის, შესაძლო გაწყლიანების კვლევის შედეგები და მეწყრის უსაფრთხოების კოეფიციენტის (FS) შეფასება რამდენიმე მეწყრისათვის.

Поиск воды и изучение оползней с использованием электроразведки

Н.Д. Варамашвили, Д.В. Тефнадзе, Д.З. Амилахвари, Л.Б. Двали, Т.Г. Чикадзе, Г.Т. Каджая, Д.Н. Варамашвили

Резюме

Электроразведка - это область геофизических методов, которая изучает электромагнитные поля различной природы. Целью этих исследований является определение электромагнитных характеристик геологической среды (сопротивления, проводимости, поляризации и т. Д.), которые могут предоставить ценную информацию о структуре исследуемой области или региона. В зависимости от типа электромагнитных полей электрическое зондирование можно разделить на две группы: первая - объединяет методы исследования естественных, вторая - искусственных электромагнитных полей. Первый называется методами естественного электрического поля (bv), а второй - методами сопротивления. Материалы, представленные в нашей работе, получены методом сопротивления (вертикального электрического зондирования). В статье представлен краткий обзор результатов различных видов работ. Представлены результаты исследований возможной влажности горных пород и наличия подземных вод на разных глубинах. Также представлены результаты литологии горных пород в зонах оползней, исследования возможной влажности и оценки коэффициента безопасности оползней (FS) для нескольких оползней.

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Reaction of the Geomagnetic Network on the Earthquakes Preparation Process in Georgia

[1]Tamar J. Jimsheladze, [1]George I. Melikadze, [1]Genadi N. Kobzev, [1,2]Marina S. Devidze, [1]Robert A. Gogua, [1]Tamaz G. Matiashvili, [1]Nino T. Goguadze, [1]Elene V. Chikviladze, [1]Aleksandre Sh. Tchankvetadze, [1]Nino A. Kapanadze, [1]Ketevan Sh. Qurtsikidze

[1]Iv. Javakhishvili Tbilisi State University, M. Nodia Institute of Geophysics
melikadze@gmail.com
[2]Institute of Geosciences and Earth Resources CNR Pisa, Italy

ABSTRACT

In terms of geodynamic, Georgia is one of the most active region. The macro structural factor here is represented by the contact with the Arabian and Eurasian tectonic plates, which in addition to the geological diversity of the area conditions the high seismicity of mentioned region. The article represents the observations of following seismic processes such as: geomagnetic field and low frequency electromagnetic radiation (VLF).

Key Words: Geomagnetic anomalies, seismic event precursors.

Introduction

The stationary observation of magnetic field is carried out at two stations: Dusheti geomagnetic observatory (Lat. 42.088° N, Lon. 44.701° E) and seismological station Oni (Lat. 42.573° N, Lon. 43.437° E) which are located on the highly seismologically active areas.

During a long period of observation there have been identified individual cases in which stations Oni and Dusheti reacted to the earthquake preparation process [1-4]. In order to show the mentioned fact and the data analyze in general there is given three Month period bellow as an example (March-May, 2019).

Data analysis

During the mentioned period several medium earthquakes occurred in our region (M<5). It turned out that all earthquakes (except one) did not have any remarkable geomagnetic effect. Only earthquakes of 4th March and 16th May, 2019 showed the synchronized reaction on the both stations (Fig. 1, 4, 7, 10).

We observed the synchronized reaction on earthquake of 4th march, 2019 , (M 3.7). the epicenter was located on 250 km and 166 km from Dusheti and Oni stations correspondingly.

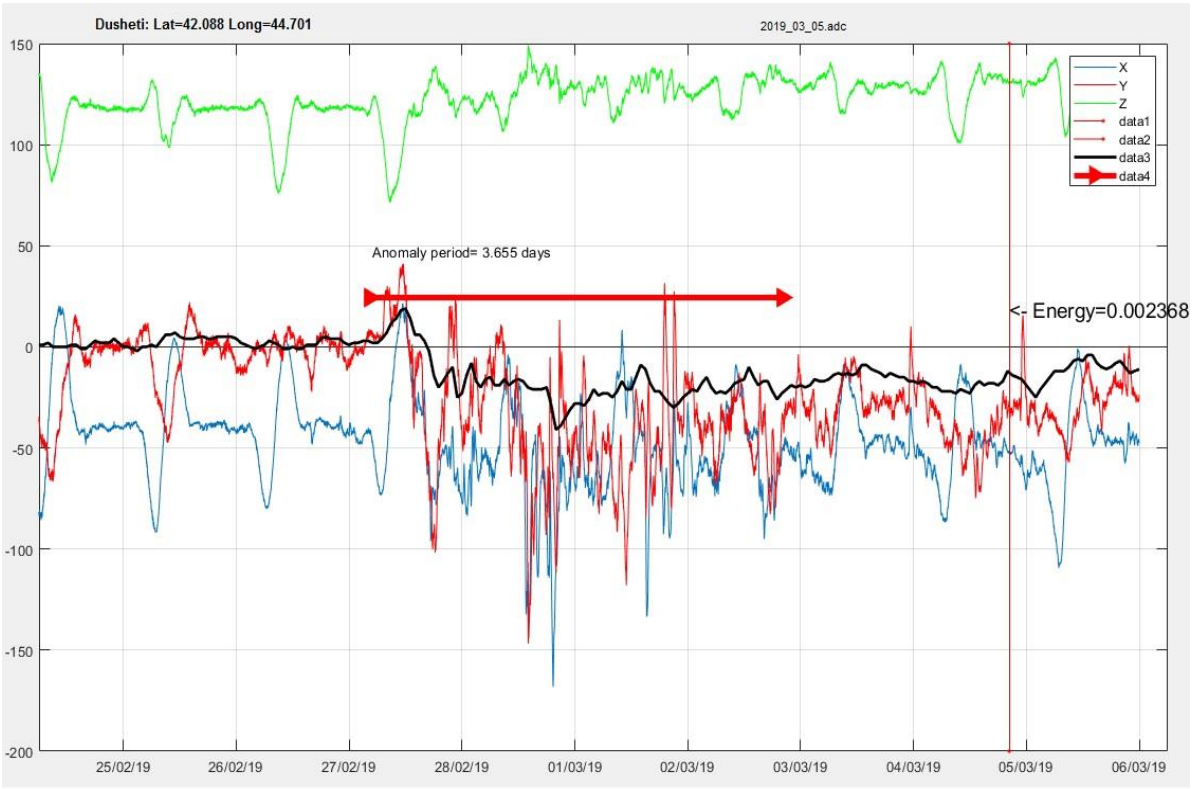

Fig.1. Variation of VLF index and X, Y, Z components of the magnetic field, Dusheti.

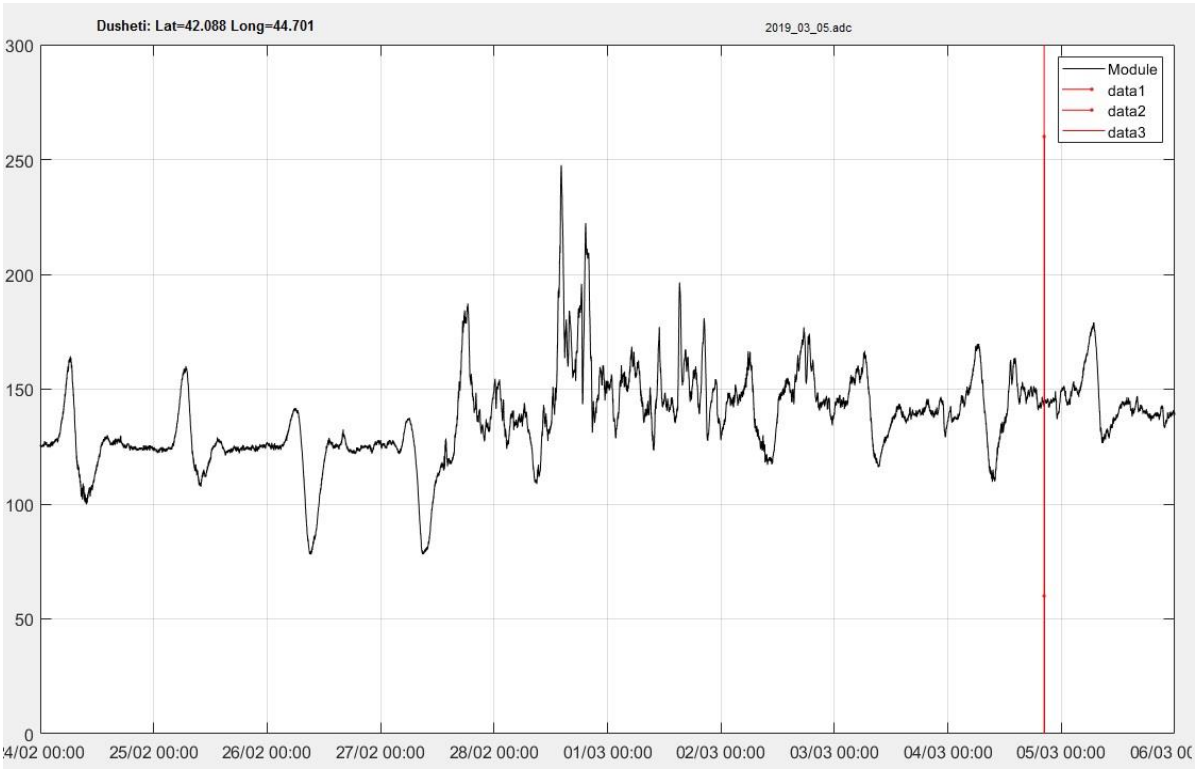

Fig. 2. Variation of the module value, Dusheti

Fig. 3. Variation of VLF index and X, Y, Z components of the magnetic field, Oni.

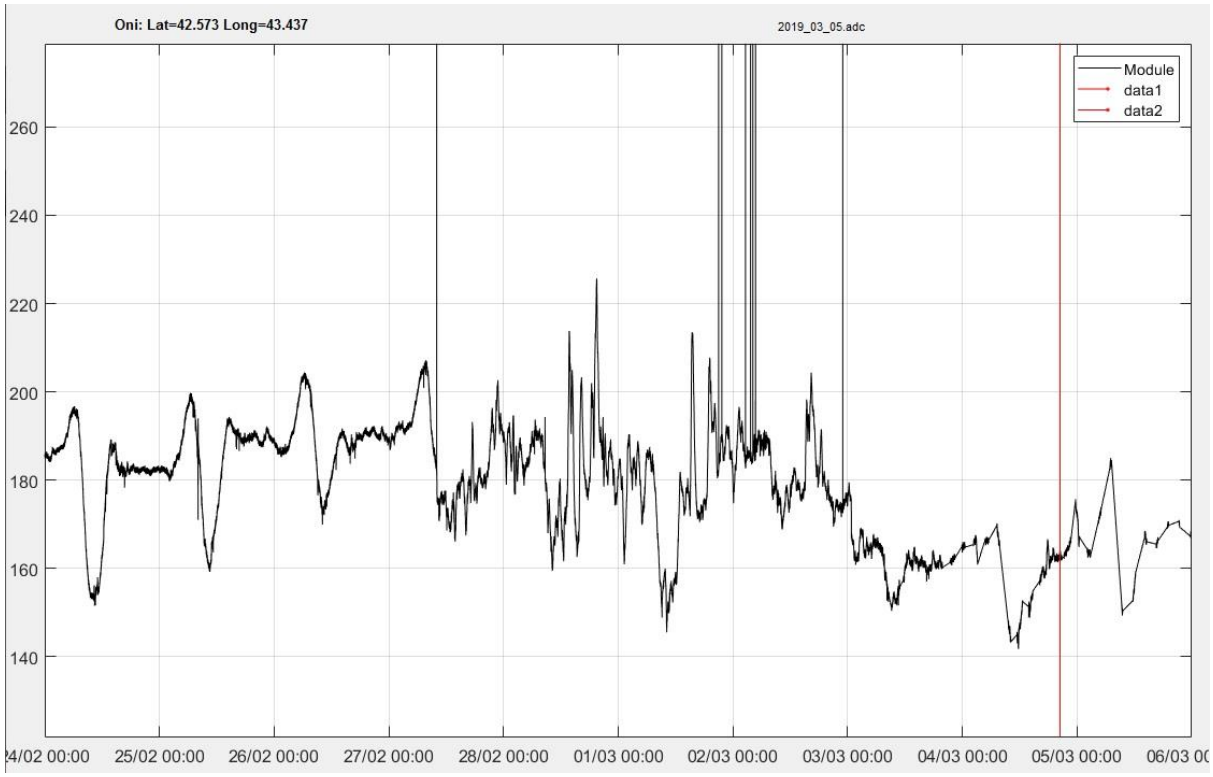

Fig.4. Variation of the module value, Oni.

The synchronized reaction was observed also on earthquake of 19th May, 2019 , (M 3.5; Depth 2 km). The epicenter was located on 130 km and 94 km from Dusheti and Oni stations correspondingly.

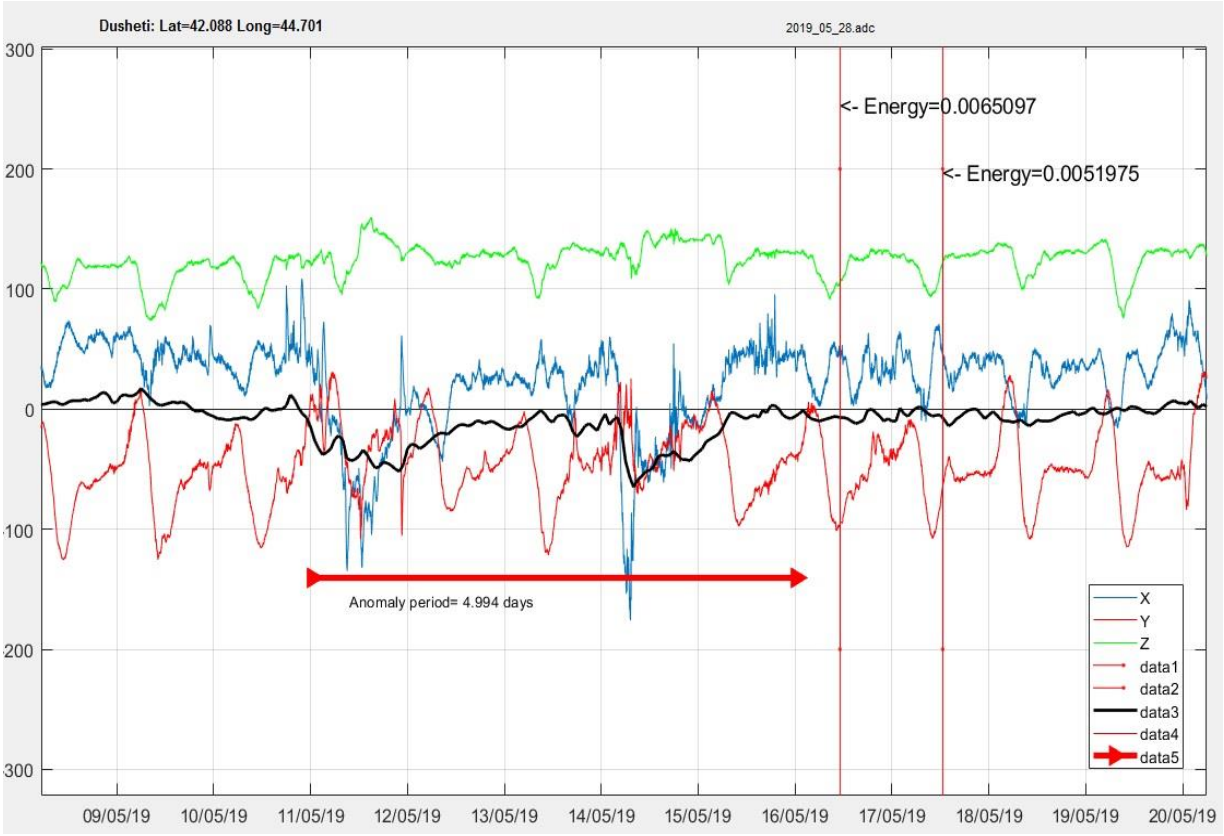

Fig.5. Variation of VLF index and X, Y, Z components of the magnetic field, Dusheti.

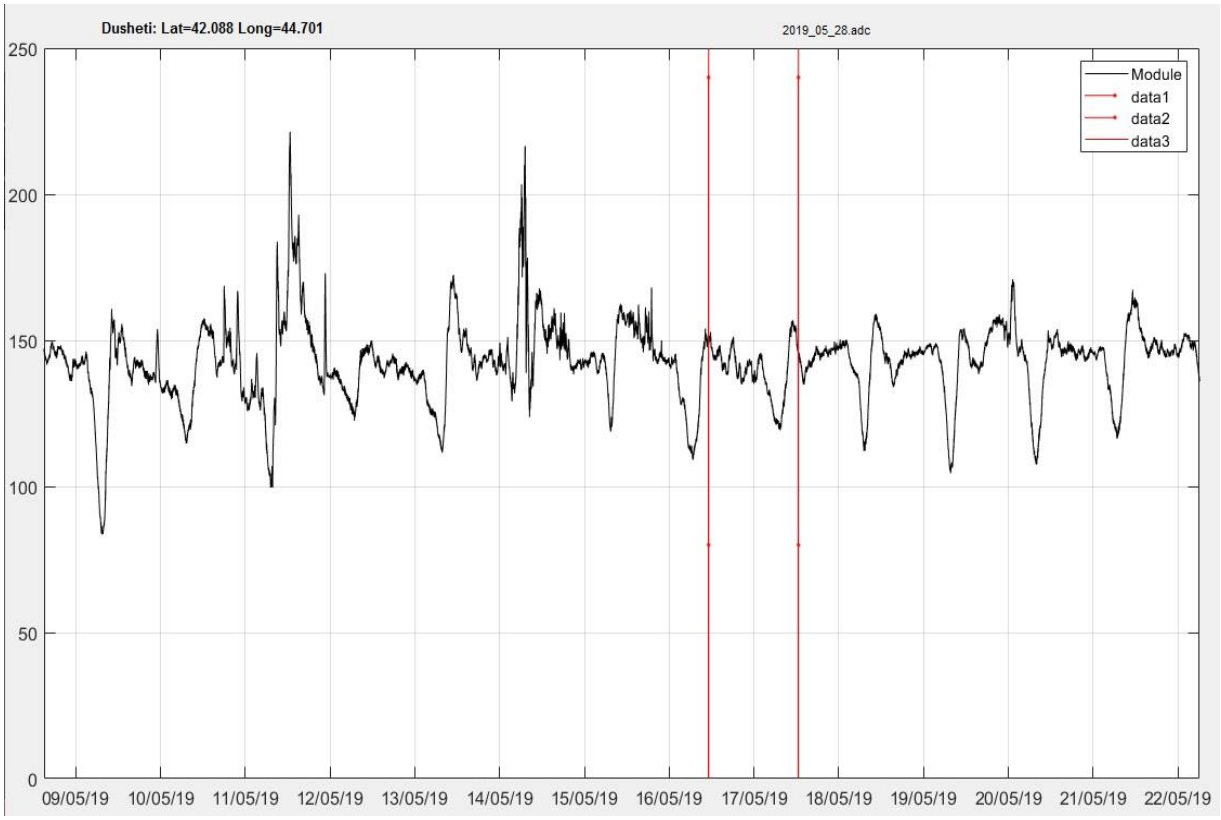

Fig. 6. Variation of the module value, Dusheti.

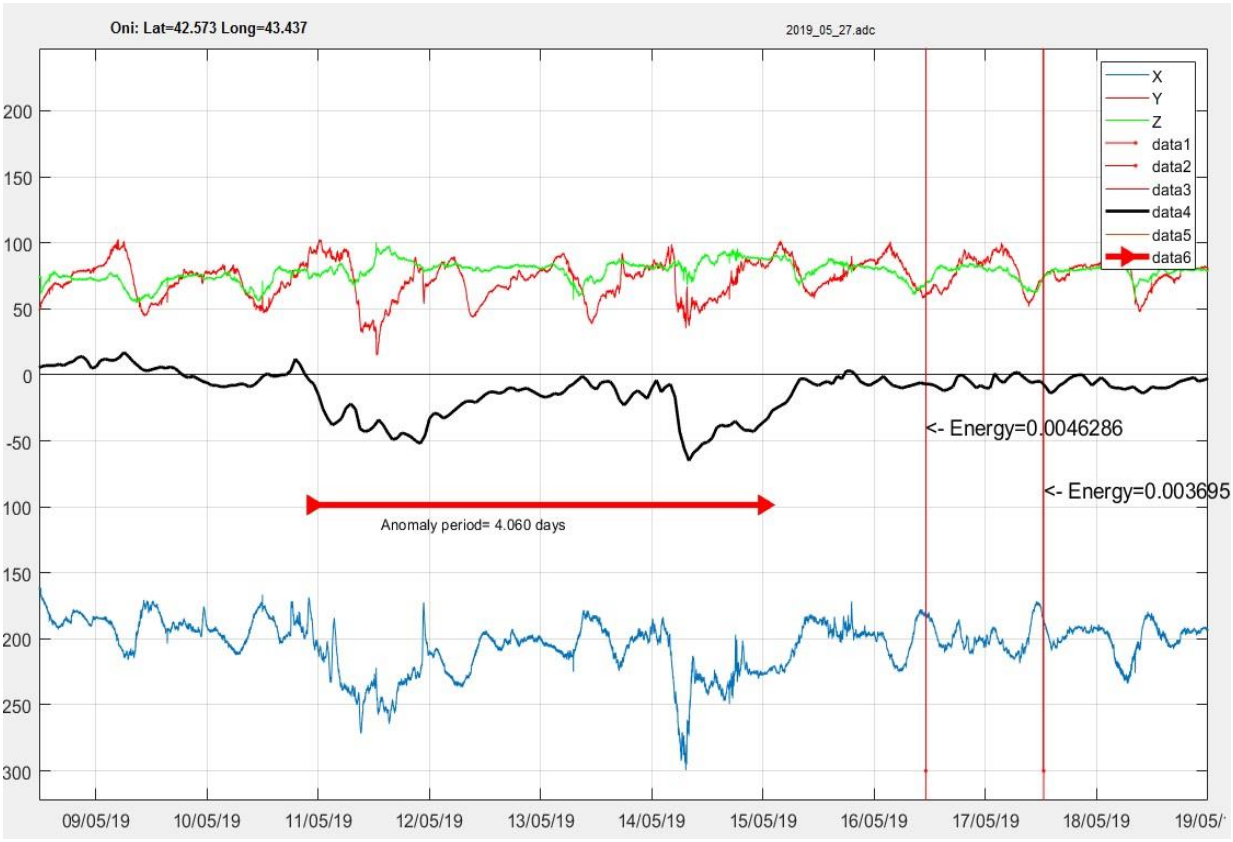

Fig. 7. Variation of VLF index and X, Y, Z components of the magnetic field, Oni

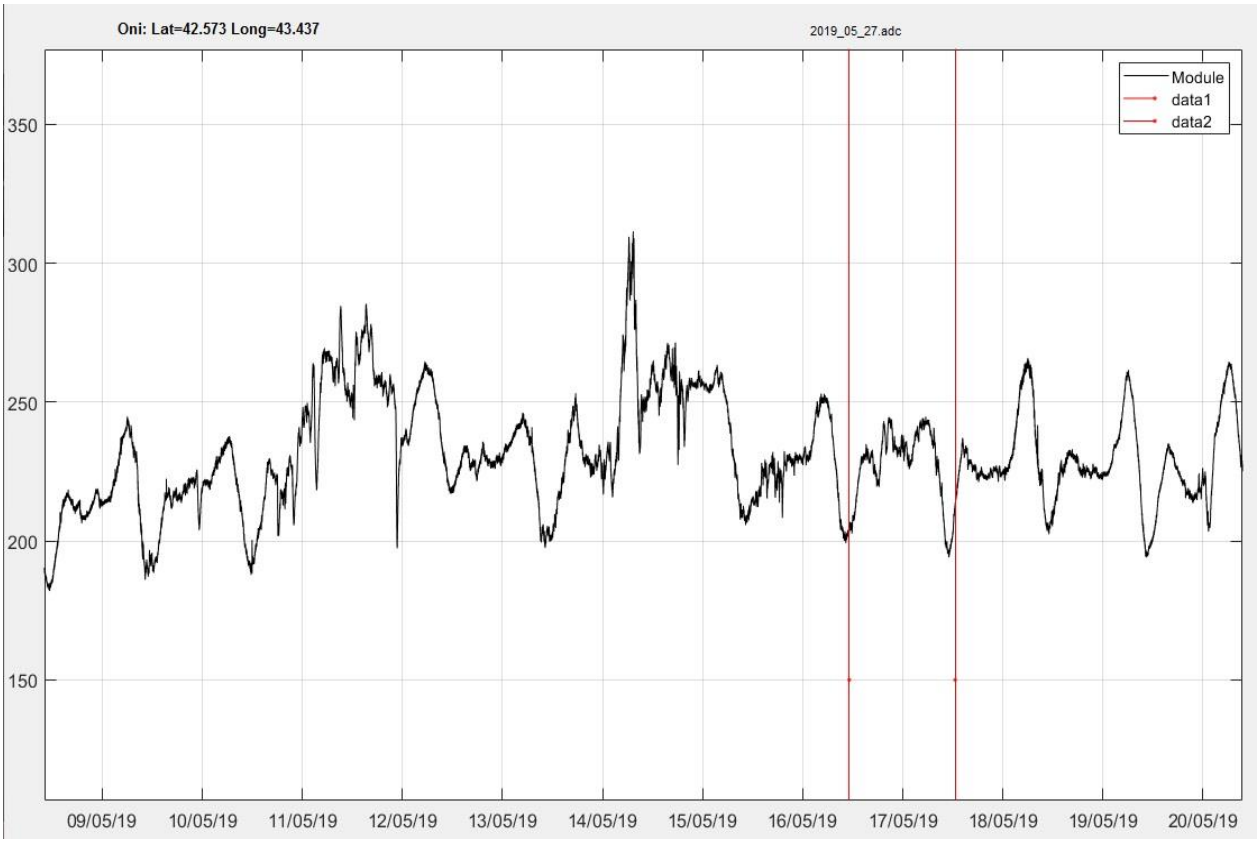

Fig. 8. Variation of the module value, Oni.

Conclusions

Fig. 1, 3, 5, 7 shows the VLF index and the trend of X, Y, Z components of variable geomagnetic field at both stations. Despite the fact that the sensitivity of magnetometers differ from each other, we observe the synchronism of pulsations. But should be mentioned that according to the VLF index we observe the effect of global magnetic source, which covers remarkable period of time before the earthquake.

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გეომაგნიტური ქსელის რეაქცია მიწისძვრის მომზადების პროცესზე საქართველოში

თ. ჯიმშელაძე, გ. მელიქაძე, გ. კობზევი, მ. დევიძე, რ. გოგუა,
თ. მათიაშვილი, ნ. გოგუაძე, ე. ჩიქვილაძე, ა. ჭანკვეტაძე,
ნ. კაპანაძე, ქ. ქურციკიძე

რეზიუმე

გეოდინამიკური პროცესების არაცალსახობის თვალსაზრისით საქართველო მიეკუთვნება ერთ- ერთ განსაკუთრებულად რთულ რეგიონს. მაკრო სტრუქტურული ფაქტორი აქ არის არაბეთისა და ევრაზიის ტექტონიკური ფილების კონტაქტი, რასაც ემატება ლოკალურ გეოლოგიური სტრუქტურული მრავალფეროვნება, თუმცა ყველა ეს ადგილი გამოირჩევა მღალი სეისმურობით. სტატიაში წარმოდგენილია სეისმური პროცესების მომდინარეობის ისეთ ინდიკატორებზე დაკვირვება როგორიცაა: გეომაგნიტური ველი და მეტად დაბალი სიხშირის ელექტრომაგნიტური გამოსხივება (მდს).

Реакция геомагнитной сети на процессы подготовки землетрясений в Грузии

Т. Дж. Джимшеладзе, Г.И. Меликадзе, Г.Н. Кобзев, М.С. Девидзе, Р.А. Гогуа, Т.Г. Матиашвили, Н.Т. Гогуадзе, Э.В. Чиквиладзе, А.Ш. Чанкветадзе, Н.А. Капанадзе, К.Ш. Курцикидзе

Резюме

С точки зрения геодинамики Грузия является одним из наиболее активных регионов. Макроструктурный факторздесь представлен контактом с Аравийской и Евразийской тектоническими плитами, что в дополнение к геологическому разнообразию района обуславливает высокую сейсмичность указанного региона. В статье представлены наблюдения следующих сейсмических процессов таких как: геомагнитное поле и низкочастотное электромагнитное излучение (ОНЧ).

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Study of Local Wind Field in Georgia

Marika R. Tatishvili, Zurab V. Khvedelidze, Inga G. Samkharadze, Ana M. Palavandishili

Institute of Hydrometeorology of Georgian Technical University
marika.tatishvili@yahoo.com

ABSTRACT

The complex relief of Georgian territory has definite influence on air masses motion in atmosphere lower layers. Mainly west and eastern atmospheric processes prevailed over Georgian territory. Current geodynamics and orographic properties of Georgia play an important role in formation of weather various patterns. Such complex relief conditions the formation and evolution of various scaled circulation systems and heterogeneous spatial distribution of meteorological elements. This is verified by the fact, that such important parameter as wind annual distribution has diverse type, with sharply expressed spatial inhomogeneities.
The wind is one of most important meteorological element used both in science and energetic industry. However, its origin and nature isn't well understood yet. Wind direction and value in atmosphere surface layer is depending on local geographic conditions. Meteorological observation 1960-2017 data is used to carry out investigation.

Keywords*:* local wind field, renewable energy, wind velocity repeatability.

Introduction

The renewable solar, wind and bio energies became more and more actual and applicable in the World. Many studies have been devoted to study their application ways and develop equipments and devices to produce energy supply. The research of their possible energy potential is crucial for energy sector and state economics that are preconditions for sustainable development. The application of wind energy is important for Georgia. However, the wind phenomenon is still under persistent scientific investigation its nature is still unknown. There are many reasons of its genesis.

The wind is one of most important meteorological element used both in science and energetic industry. However, its origin and nature isn't well understood yet. It is especially remarkable the transformation of wind kinetic energy into electricity, which makes its value in energetic supply more and more significant. To identify the wind nature is especially important for energy sector as it makes possible to precisely determine its loading potential and share in total energetic balance of state.

Study area and methods

In Georgia due to complex orographic conditions and influence of the black Sea there exist most of Earths climatic types, from marine wet subtropical climate in west Georgia and steppe continental climate in east Georgia up to eternal snow and glaciers in high mountain zone of Great Caucasus, and also approximately 40% of observed landscapes. The Georgian relief may be characterized by three sharply expressed orographic elements: Caucasus- in north, in south – Georgian south upland and lowland or intermountain depression located between those two risings.

This one begins from The Black Sea shore namely Colchis Lowland triangle and spreads up to eastern Georgia like **a** narrow strip. Between those two uplands small scaled orographic elements can be allocated. Such complicated relief has definite influence on air masses motion in atmosphere lower layers. Mainly west and eastern atmospheric processes prevailed over Georgian territory. Current geodynamics and orographic properties of Georgia play an important role in formation of weather various patterns. Such complex relief conditions the formation and evolution of various scaled circulation systems and heterogeneous spatial distribution of meteorological elements. This is verified by the fact, that such important parameter as wind annual distribution has diverse type, with sharply expressed spatial inhomogeneities.

The weather and climate driven factor is solar irradiance. The variations in the Sun's magnetic flux control the amount of cosmic rays impinging on the atmosphere. Cosmic rays produce ionizations and the ions form nuclei for cloud formation. Cloud cover has a great effect on global temperature, but this area is still poorly understood and not addressed in climate models. Meteorological effects resulting from fluctuations in the solar wind are presently poorly represented in weather and climate models. Geomagnetic storm is a major disturbance of Earth's magnetosphere that occurs when there is a very efficient exchange of energy from the solar wind into the space environment surrounding Earth. These storms result from variations in the solar wind that produces major changes in atmosphere circulation on the Earth

Wind velocity repeatability is presented on map 1 [3]. As it is evident from the map there exist some local areas with strong winds.

One of such area is near Gori and this location has been chosen for construction first wind power plant. The station works smoothly and its efficiency is 54%, which is a high rate for such a station. Since the Kartli wind power station has been moving from the test drive to electricity generation regime, it has never stopped functioning, the energy generated by the power plant has been fully delivered to Georgia's electricity system (5.5 million kW) since December 1, and it provided 10 572 kilowatt hours energy. The wind power is the essential and most important precondition for producing electricity. The power plant requires a wind speed of at least 3 m / sec to start generating energy, and its further development is directly proportionate to the wind speed. According to the current year December data, the efficiency of Kartli wind power generation is 54%, which is one of the best indicators in the world

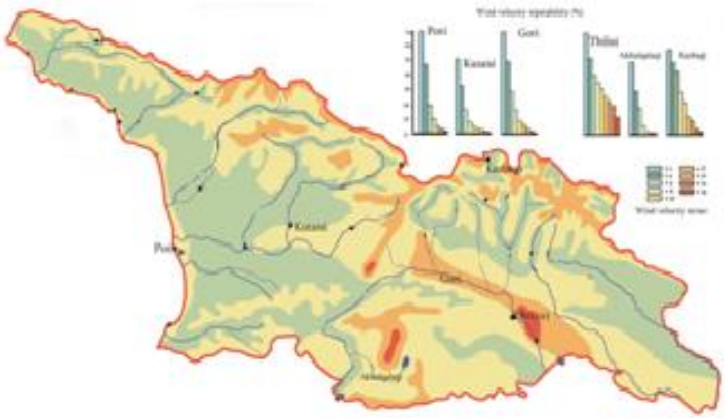
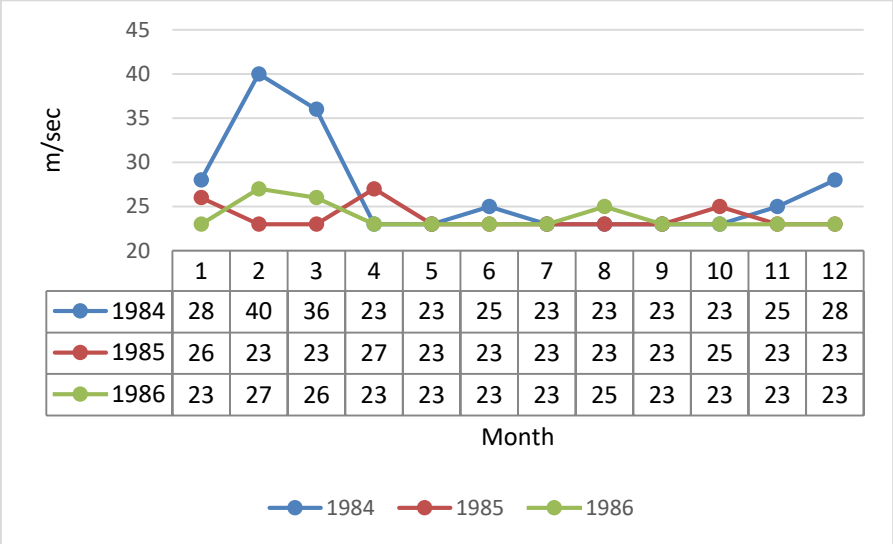


Fig.1. Wind field distribution in Georgia

Particularly wind is air masses horizontal and vertical motion caused by temperature and pressure gradient. Due to Earth motion wind is enforced by Coriolis force. In middle latitudes dominate motion caused by pressure gradient, parallel to isobars. The influence of friction and orography on air masses motion is important, as they resist motion and force it to replace toward low pressure area. Wind direction and velocity at atmosphere surface layer depends on local geographical conditions.

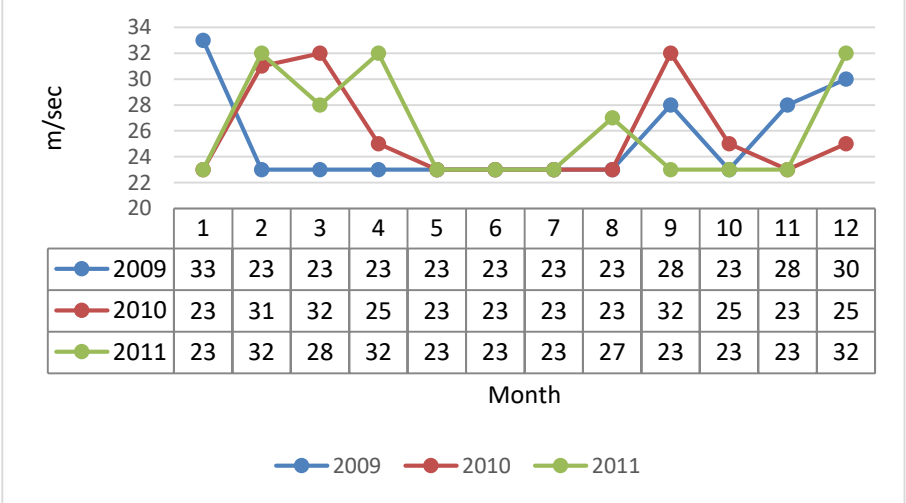
Except Gori there are a lot of windy regions in Georgia such as: Kutaisi, Tbilisi and Telavi, the notable is that those regions have different thermal and dynamical conditions. Wind observation 50 year period (1960-2014) data for Kutaisi have been processed and divided by 5m/sec interval gradation beyond 15m/sec. It may be concluded that 1 gradation wind occurs mainly in February-March and second gradation occurs mainly in January-March.

Wind maximal velocity variability by month has sinusoidal character; wind maximal values were detected in February-March and minimal in July (Fig.3, 4,5)



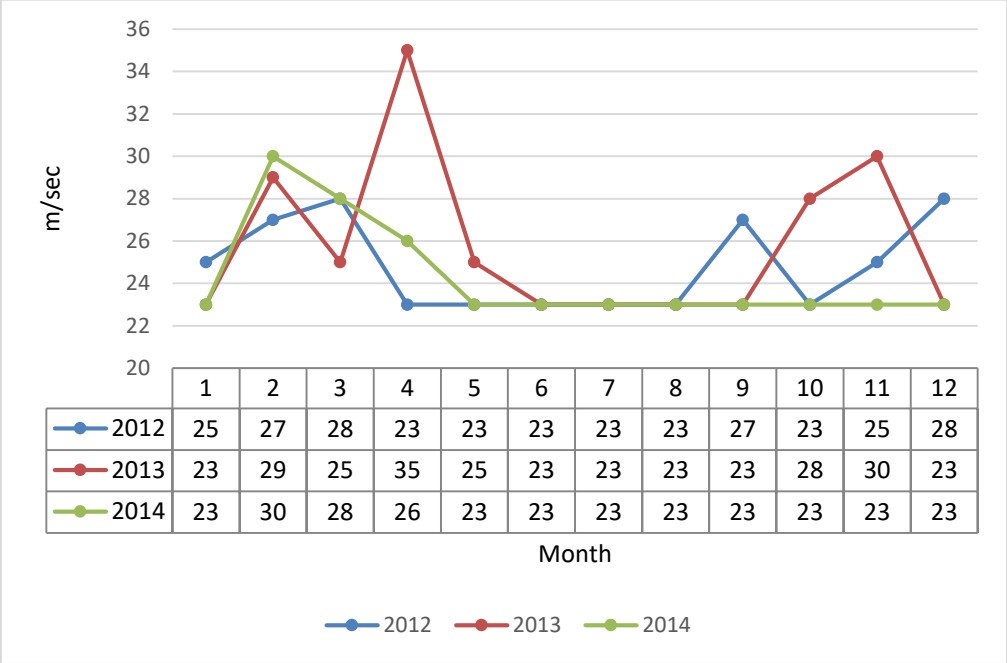
	1	2	3	4	5	6	7	8	9	10	11	12
1984	28	40	36	23	23	25	23	23	23	23	25	28
1985	26	23	23	27	23	23	23	23	23	25	23	23
1986	23	27	26	23	23	23	23	25	23	23	23	23

Fig.3. Wind maximal velocity distribution by years (1984-1986).



	1	2	3	4	5	6	7	8	9	10	11	12
2009	33	23	23	23	23	23	23	23	28	23	28	30
2010	23	31	32	25	23	23	23	23	32	25	23	25
2011	23	32	28	32	23	23	23	27	23	23	23	32

Fig.4. Wind maximal velocity distribution by years (2009-2011).

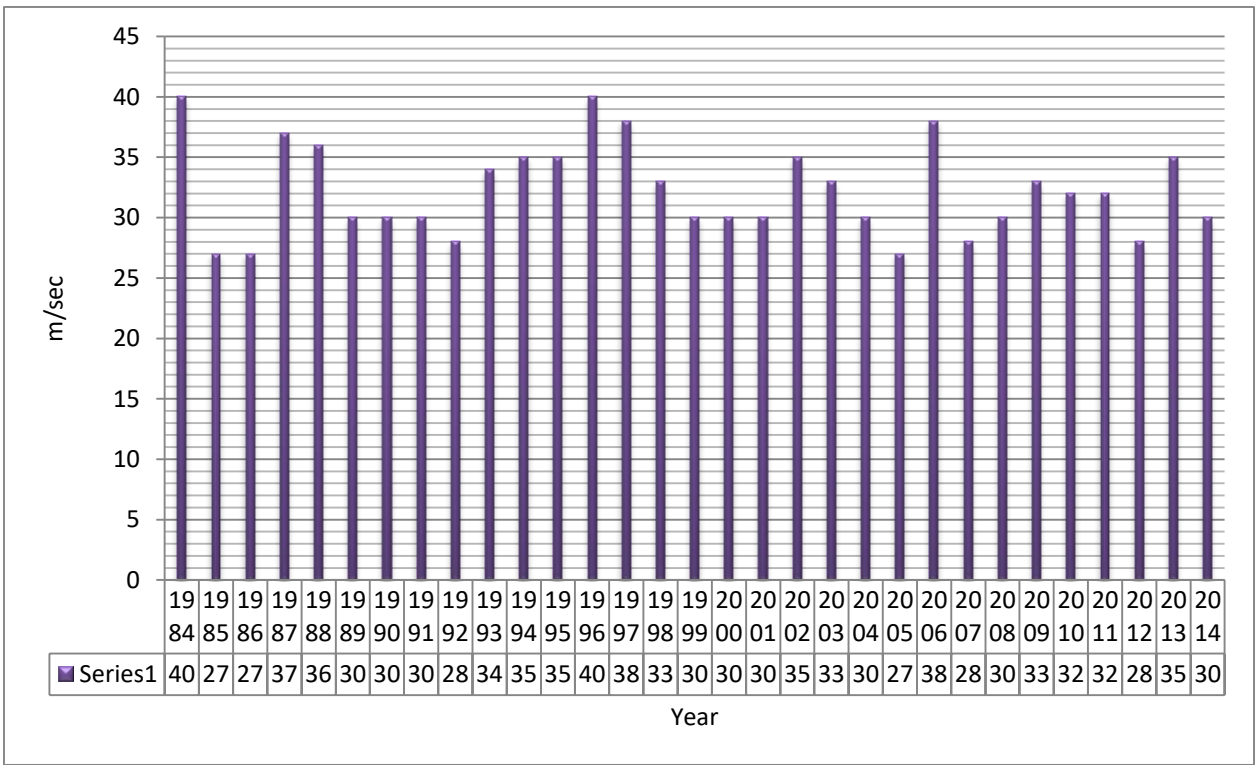


	1	2	3	4	5	6	7	8	9	10	11	12
2012	25	27	28	23	23	23	23	23	27	23	25	28
2013	23	29	25	35	25	23	23	23	23	28	30	23
2014	23	30	28	26	23	23	23	23	23	23	23	23

Fig.5. Wind maximal velocity distribution by years (2012-2014).

To understand wind extreme velocity character 1984-2014 data had been treated and results are presented.

The wind velocity has sinusoidal character and its maximal value reaches 40m/sec. It is remarkable that wind extremes lower threshold for last years has been increased.



	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Series1	40	27	27	37	36	30	30	30	28	34	35	35	40	38	33	30	30	30	35	33	30	27	38	28	30	33	32	32	28	35	30

Fig.6. Wind maximal velocity (>25m/sec) distribution for Kutaisi region (1984-2014).

Table 1. Possible wind velocity$_{max}$ (m/sec) occurred once in 1- 2-5-10- 15- 20- 50- 100 year

Station	Possible wind velocity$_{max}$ (m/sec) occurred once in 1- 2-5-10- 15- 20- 50- 100 year							
	1	2	5	10	15	20	50	100
Batumi	19	27	31	34	36	38	42	45
Bakuriani	17	23	26	30	31	33	38	42
Bakhmaro	16	30	35	38	40	40	43	44
Borjomi	8	17	23	27	30	31	37	41
Gardabanio	8	20	25	27	28	29	31	32
Gori	18	26	29	32	33	34	36	38
Gudauta	16	20	22	23	23	24	25	26
Gurjaani	13	20	25	28	30	32	37	41
Dedoplistskaro	23	31	35	37	38	39	40	41
Dusheti	19	23	25	26	26	27	28	28
Zestaphoni	12	24	29	31	32	32	34	35
Zugdidi	17	21	25	29	32	34	41	48
Tbilisi	23	30	32	33	33	33	34	34
Tetritskaro	16	24	29	33	34	36	40	43
Telavi	15	24	27	29	30	30	32	32
Lagodekhi	8	23	27	28	29	29	30	30
Lanchkhuti	24	31	35	36	37	38	40	41
Martvili	12	29	35	39	40	41	44	45
Mestia	11	19	24	27	28	30	33	36
Mta-Sabuati	17	33	39	41	42	42	44	45
Mukhrani	18	31	37	39	41	41	44	45
Sagarejo	17	26	29	30	30	30	31	31
Samtredia	22	28	32	34	35	36	39	40
Stepantsminda	17	22	26	30	33	35	44	52
Tkibuli	19	29	34	37	39	40	43	46
Paravani	24	35	40	43	45	46	48	50
Pasanauri	12	18	23	28	30	32	39	46
Poti	22	27	30	32	33	34	36	37
Kutaisi	26	33	37	40	42	43	48	51
Khashuri	18	20	22	25	26	27	32	37

All possible wind maximal velocity repeatability over 1-2-5-10-15-20-5-100 years is presented in Table 1.

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ლოკალური ქარის გამოკვლევა საქართველოში

მ. ტატიშვილი, ზ. ხვედელიძე, ი. სამხარაძე, ა. ფალავანდიშვილი

რეზიუმე

საქართველოს ტერიტორიის რთული რელიეფი გარკვეულ გავლენას ახდენს ატმოსფეროს ქვედა ფენებში ჰაერის მასის მოძრაობაზე. ძირითადად, დასავლეთის და აღმოსავლეთის ატმოსფერული პროცესები პრევალირებს საქართველოს ტერიტორიაზე. საქართველოს ამჟამინდელი გეოდინამიკა და ოროგრაფიული თვისებები მნიშვნელოვან როლს თამაშობენ ამინდის სხვადასხვა ტიპების ჩამოყალიბებაში. ასეთი რთული რელიეფი განაპირობებს სხვადასხვა მასშტაბის ცირკულაციური პროცესების ფორმირებას და განვითარებას და მეტეოროლოგიური ელემენტების ჰეტეროგენულ სივრცითი განაწილებას. ამას ადასტურებს ის ფაქტი, რომ ასეთი მნიშვნელოვანი პარამეტრი, როგორც ქარის წლიური განაწილება, მრავალფეროვანია, მკვეთრად გამოხატული სივრცითი არაჰომოგენურობით.

ქარი წარმოადგენს ერთ-ერთ ყველაზე მნიშვნელოვან მეტეოროლოგიურ ელემენტს როგორც მეცნიერების, ასევეა ენერგეტიკის სფეროში. თუმცა მისი წარმქმნის მექანიზმი და ბუნება ჯერჯერობით კარგად არ არის შესწავლილი. ქარის მიმართულება და სიდიდე ატმოსფეროში მიწისპირა ფენაში დამოკიდებულია ადგილობრივ გეოგრაფიულ პირობებზე. კვლევის ჩატარების მიზნით გამოყენებული იქნა 1960-2017 წლის მეტეოროლოგიური დაკვირვებების მონაცემები.

Изучение местного ветрового поля в Грузии

М. Р. Татишвили, З.В. Хведелидзе, И.Г. Самхарадзе,
А. М. Палавандишили

Резюме

Сложный рельеф территории Грузии оказывает определенное влияние на движение воздушных масс в нижних слоях атмосферы. В основном над территорией Грузии преобладют западные и восточные атмосферные процессы. Современная геодинамика и орографические свойства Грузии играют важную роль в формировании погодных условий. Такой сложный рельеф обуславливает формирование и эволюцию различных масштабных циркуляционных систем и неоднородное пространственное распределение метеорологических элементов. Это подтверждается тем фактом, что такой важный параметр, как годовое распределение ветра, имеет неодинаковый вид с резко выраженными пространственными неоднородностями.

Ветер является одним из важнейших метеорологических элементов, используемых как в науке, так и в энергетике. Однако происхождение и природа ветра еще не совсем понятны. Направление и значение ветра в приземном слое атмосферы зависит от местных географических условий. Данные метеорологических наблюдений 1960-2017 гг. используются для проведения исследований.

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About the Use of Anti-Hail Rockets "Loza-2" in the Work of Anti-Hail System in Kakheti (Georgia)

[1]Avtandil G. Amiranashvili, [1]Victor A. Chikhladze, [2]Ucha V. Dzodzuashvili, [2]Ioseb P. Sauri, [2]Shmagi O. Telia

[1]M. Nodia Institute of Geophysics of I. Javakhishvili Tbilisi State University,
e-mail:avtandilamiranashvili@gmail.com
[2]Military Scientific-Technical Center "DELTA"

ABSTRACT

In the Kakheti region of Georgia in the work of anti-hail system anti-hail rockets "Loza-2" of the production of Bulgaria from September 2018 are used. Some results of the calculations of the optimum areas of cloud seeding by the crystallizing reagent for more than 80 points of action located on the protected territory in Kakheti are given. The characteristics of the anti-hail rockets "Loza-2" and "Trayal D 6-B" are compared.

Key Words: Weather modification, anti-hail rockets.

Introduction

In Georgia special attention is paid to the scientific and practical works on the fight with the hail [1-3]. Production work on the fight with the hail here was conducted in the period from 1967 through 1989 [2,3]. Taking into account importantly this problem [4] with the support of the government of Georgia, to the active operation of Scientific-Technical center "Delta", the collaborators of institute of geophysics and institute of hydrometeorology, the work of anti-hail service in Kakheti in the end of May 2015 was restored [5-7].

From the set of anti-hail items in 2015 year it was possible to acquire the anti-hail rockets SK-6 of the productions of Macedonia [2,6,8-10], which were used until August 2016. From September 2016 to August 2018 for dealing with the hail anti-hail rockets "Trayal D 6- B" of the production of Serbia were used [11,12]. From September 2018 to present anti-hail rockets "Loza-2" of the production of Bulgaria are used [13].

Some results of the calculations of the optimum areas of cloud seeding by the crystallizing reagent of anti-hail rockets "Loza-2" for more 80 points of action located on the protected territory in Kakheti are given below. The characteristics of the anti-hail rockets "Loza-2" and "Trayal D 6-B" are compared also.

Material and methods

To protect the whole region of Kakheti (800 thousand hectares) in 2018-2019 more than 80 launching points were used. There is a rocket launching device, solar panel, grounding and security

systems installed on the launching site. The launching device carries 26 anti-hail rockets, aims to any given direction and fires [10]. The launchers at the heights from 205 to 1775 m above sea level placed [12].

The anti-hail rocket „Loza-2“ the production of Bulgaria (fig. 1) is an unguided, 55 mm rocket, which carries $1.28 \cdot 10^{16}$ particles of silver iodide reagent and disperses it for 30 seconds [13]. Some parameters of anti-hail rocket „Loza-2“ is represented lower.

Fig. 1. Anti-hail Rockets „Loza-2“ (photo in real form and in the container for transport).

Anti-hail rocket „Loza-2“ technical parameters [13].

- Rocket quantity in launching device SD-26 or SD-52: 26-52 rockets
- Elevation: 55-80°
- Traverse: 360°
- Rocket diameter: 55 mm
- Rocket length: 876 mm
- Rocket weight: 3300 gram
- Initial speed of rocket: 70 m/sec
- Rocket maximum velocity: 600 m/sec
- Shoot maximum distance at sea level (elevation 55°): 7900 meter
- The maximum from sea level (elevation 80°): 5800 meter
- Mass of reagent: 400 gram
- The outlet of reagent from the rocket at a temperature -10°C – $1.28 \cdot 10^{16}$ particles
- Reagent emission start: 7-10 sec
- Duration of the reagent emission: 30 sec
- Diameter of the dissipated reagent: 5 m

Data about concentration of reagent in the initial volume of the flight paths of different anti-hail rockets in table 1 are presented [2,8-10].

As follows from this table, the concentration of the reagent in the initial volume of the flight path of the “Loza-2” rocket is quite high and commensurate with such modern rocket as “Alazan-9”, “Alan-2”, “Ac”, “SK-6” [2,8-10].

Table 1

Concentration of reagent in the initial volume of the flight paths of different anti-hail rockets, m^{-3}

The initial radius of the route, m	Alazan-2M	Alazan-6	Alazan-9	Alan-2	Ac	SK-6	Trayal D-6B	Loza-2
2-2.5	2.5E+10	4.2E+10	7.5E+10	6.6E+10	1.6E+11	1.1E+11	3.5E+10	1.19E+11

The calculations of the optimum areas of cloud seeding by the crystallizing reagent it was carried out taking into account level of the zero isotherm (and isotherm -6.0 °C) [14-16] and also heights of the arrangement of launchers.

Results and discussion

The results of calculations on Fig. 2-6 and table 2 are presented.

As follows from fig. 2-6 and table 2 optimum areas of cloud seeding by the crystallizing reagent depend on the height of the arrangement of launchers and level of isotherm -6°C. Distribution of the optimum areas of cloud seeding by reagent is unevenly. Basic reason for this - the insufficiently long courses of the rocket “Loza-2” (as and rocket “Trayal D-6B” [12]).

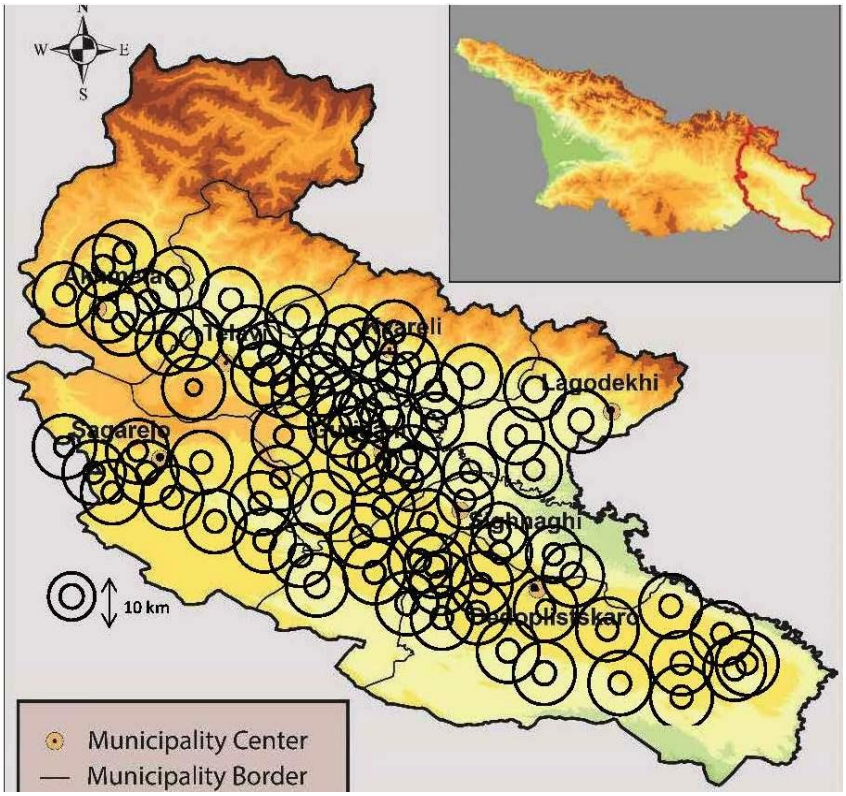

Fig. 2. Optimum areas of cloud seeding by the crystallizing reagent for the points of action by anti-hail rockets “Loza-2” in the protected territory in Kakheti. Height of the isotherm -6°C = 3.6 km.

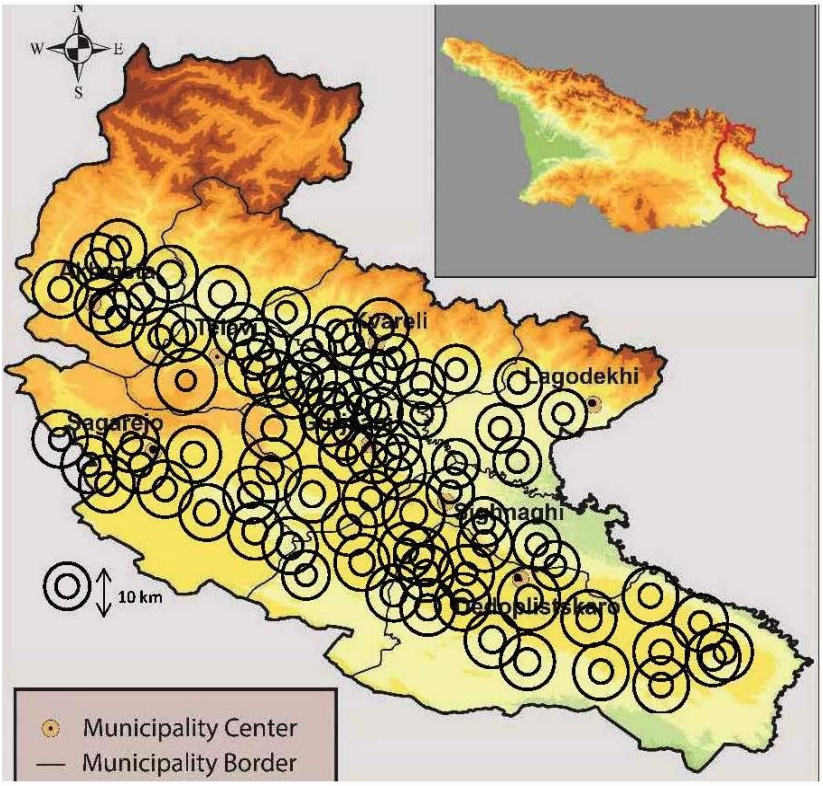

Fig. 3. Optimum areas of cloud seeding by the crystallizing reagent for the points of action by anti-hail rockets "Loza-2" in the protected territory in Kakheti. Height of the isotherm -6°C = 4.4 km.

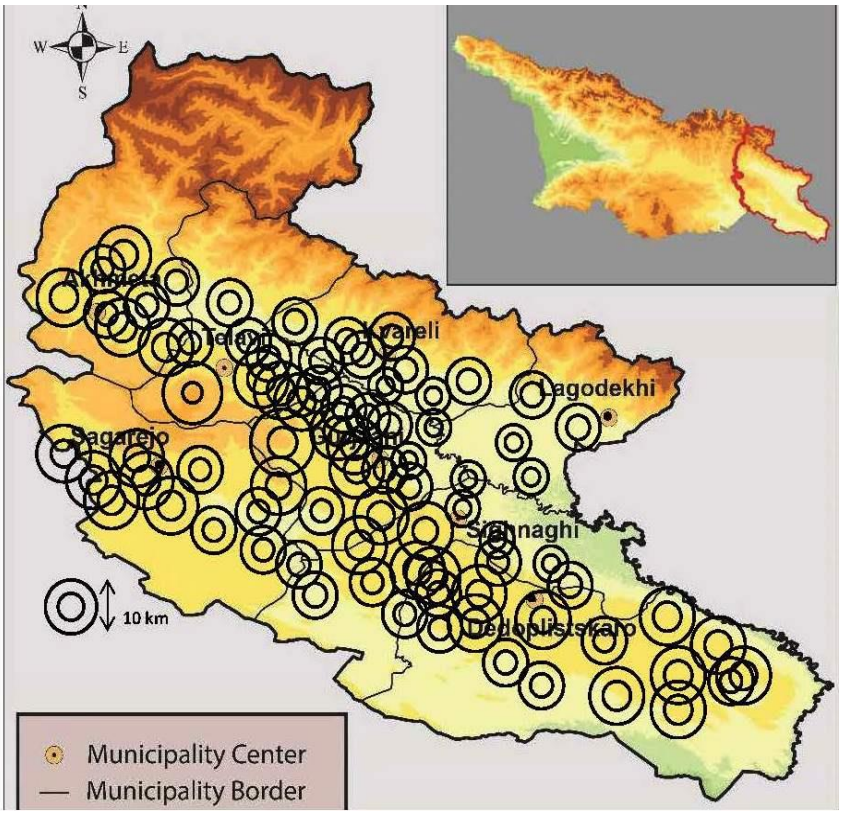

Fig. 4. Optimum areas of cloud seeding by the crystallizing reagent for the points of action by anti-hail rockets "Loza-2" in the protected territory in Kakheti. Height of the isotherm -6°C = 5.2 km.

Table 2

Comparison of the characteristics of cloud seeding by reagent from the rockets “Loza-2” and “Trayal D-6B”

X1 - beginning of the optimal seeding route, X2 - end of the seeding route, (X2-X1) - optimal length of the horizontal projection of the seeding route, S - optimal horizontal seeding area, the height of the point of action: 250-550 m a.s.l.

H T(-6°C), km	Loza-2	Trayal D-6B	Loza-2	Trayal D-6B	Loza-2	Trayal D-6B	Loza-2	Trayal D-6B
	X1, km	X1, km	X2, km	X2, km	(X2-X1), km	(X2-X1), km	S, km²	S, km²
3.2	2.1	2.7	6.6	6.3	4.5	3.6	123	101
3.6	2.4	2.7	6.4	6.1	4.0	3.4	113	93
4.0	2.4	2.3	5.9	5.5	3.5	3.2	93	78
4.4	2.5	2.1	5.6	4.9	3.1	2.8	78	62
4.8	2.2	1.9	4.7	4.1	2.5	2.2	56	42
5.2	2.0	1.8	4.1	3.6	2.0	1.8	39	32
5.6	1.8	1.7	3.3	3.1	1.5	1.4	26	22
6.0	1.8	1.4	3.1	2.3	1.2	0.9	19	11

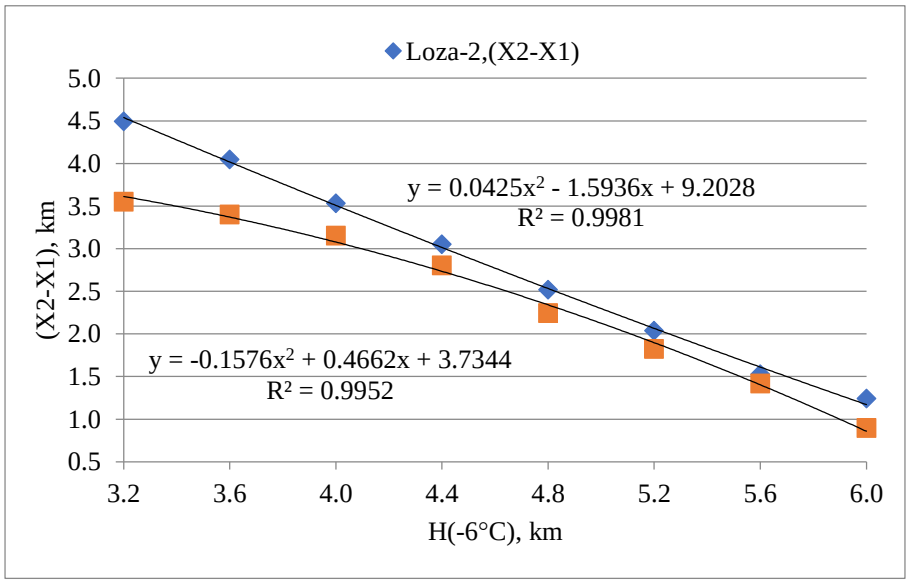

Fig. 5. Dependence of optimal length of the horizontal projection of the seeding route from the rockets “Loza-2” and “Trayal D-6B” from izoterm –6°C.
The height of the point of action: 250-550 m a.s.l.

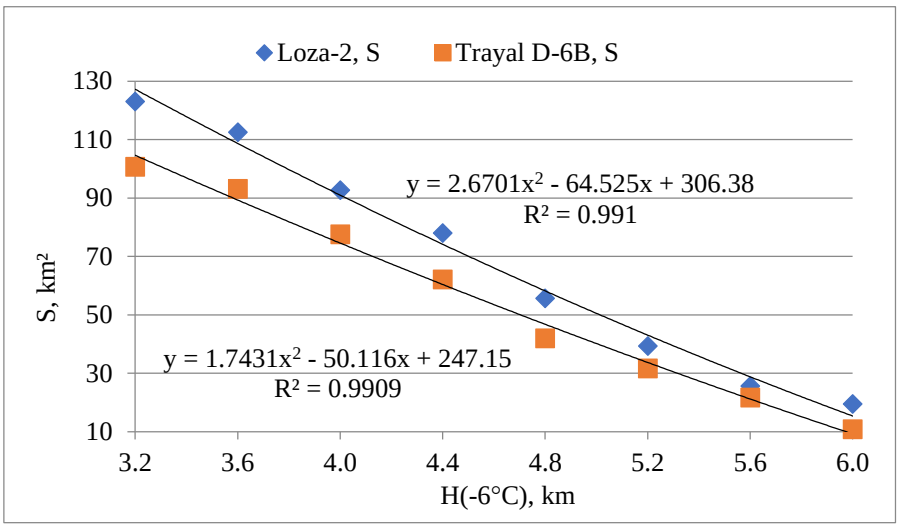

Fig. 6. Dependence of the optimal horizontal seeding area from the rockets "Loza-2" and "Trayal D-6B" from izoterm –6°C. The height of the point of action: 250-550 m a.s.l.

In general, the characteristics of the rockets "Loza-2" are slightly better than "Trayal D-6B". However, both types of the rockets are characterized by an insufficient length of the seeding path. The number of rockets „Loza-2" as and "Trayal D 6- B" needed during one year estimated to be 5000-6000 units [12].

Conclusions

In near future it is planned to improve means and methods of anti-hail protection in connection with local conditions and possibilities of obtaining the means of action and tracking of the hail clouds. The newly created distance automatic system of action on the clouds will be simultaneously improved, a question about the organization of own production of anti-hail rockets will be examined, etc. [16,17].

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კახეთის (საქართველო) სეტყვასაწინაათმდეგო სისტემის მუშაობაში “Loza-2” ტიპის სეტყვასაწინააღმდეგო რაკეტების გამოყენების შესახებ

ა.ამირანაშვილი, ვ.ჩიხლაძე, უ.ძოძუაშვილი, ი. საური, შ. თელია

რეზიუმე

2018 წლის სექტემბრიდან საქართველოში კახეთის რეგიონში სეტყვასაწინააღმდეგო სამსახურში გამოიყენება ბულგარეთის წარმოების “Loza-2” ტიპის სეტყვასაწინააღმდეგო რაკეტები. კახეთში დასაცავ ტერიტორიაზე განლაგებული ზემოქმედების 80-ზე მეტი პუნქტისთვის მაკრისტალიზებელი რეაგენტით ღრუბლების ჩათესვის ოპტიმალური ფართობების გათვლების ზოგიერთი შედეგია მოყვანილი. შედარებულია სეტყვის საწინააღმდეგო რაკეტების " Loza-2" -ის და Trayal D 6- B" -ს მახასიათებლები.

Об использовании противоградовых ракет “Loza-2” в работе противоградовой системы в Кахетии (Грузия)

А.Г. Амиранашвили, В.А. Чихладзе, У.В. Дзодзуашвили, И.П. Саури, Ш.О. Телия

Резюме

С сентября 2018 года в Кахетинском регионе Грузии в работе противоградовой системы используются противоградовые ракеты “Loza-2” производства Болгарии. Приводятся некоторые результаты расчетов оптимальных площадей засева облаков кристаллизующим реагентом для более чем 80 пунктов воздействия, расположенных на защищаемой территории в Кахетии. Проведено сравнение характеристик противоградовых ракет “Loza-2” и "Trayal D 6- B".

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Study of the Forbush Effect at the Cosmophysical Observatory of Mikheil Nodia Institute of Geophysics According to the Data of the Cosmic Ray Neutron Component

Teimuraz S. Bakradze, Irakli I. Tuskia, Nugzar Ya. Ghlonti, Tereza G. Erkomaishvili, Eteri M. Alania, Zeinab A. Kvavadze, Paata A. Barbakadze

M. Nodia Institute of Geophysics of I. Javakhishvili Tbilisi State University
e-mail: temuribakradze@yahoo.com

ABSTRACT

Cosmic ray modulation is a complex process, which includes different physical phenomena in the solar-terrestrial space. At the Cosmophysical Observatory of Mikheil Nodia Institute of Geophysics a constant registration of the neutron component of cosmic rays has been conducted for decades. The article considers 5 cases of Forbush decrease revealed as a result of observing, processing and analyzing the data obtained in 2014-2018 at the observatory. The data of the above period were compared to the data of the stations in Moscow and Irkutsk, which according to the observation data proved the existence of Forbush effect. In our opinion during the above period certain solar flares really took place. Therefore, each separate Forbush effect requires scientific studies for further analysis.

***Key words*:** cosmic rays, Forbush effect, magnetosphere.

The study in the cosmic ray modulation has played a great role in the research of the interplanetary space nature. At the Cosmophysical Observatory of Mikheil Nodia Institute of Geophysics a constant registration of the neutron component of cosmic rays has been conducted for decades [1,2]. Cosmic ray modulation is a complex process and includes different physical phenomena in the solar-terrestrial space [1-6].

The solar control module of the cosmic radiation is generally divided in different types of corresponding time scale variations: 11 years, 27 years, diurnal and Forbush types.

We will touch the Forbush type variations. The first observations on the Forbush decrease were carried out by US physicist Forbush in 1937. The effect considers an instant decrease in the cosmic ray intensity, which is significantly noticeable during a high solar activity. Observations on Forbush decrease effects started from 1838. These effects are commonly characterized with great, asymmetric and instant decrease in cosmic rays, which continues for several days. They are distributed in the whole universe, and consequently they must belong to the great variation of the geomagnetic field or the variation of the interplanetary space magnetic field. The intensity decreases by (1.5-2)% per hour and recovers by (0.02-0.05)% per hour. A whole cycle may take several days [3].

Forbush effect is a geophysical phenomenon, which always takes place when there is a great solar flare. Approximately a day after the solar burst a magnetic disturbance occurs on the Earth. At its beginning a short-term increase in the magnetic field of the Earth – by 0.1% from the normal state (an instant start) is observed. Further the magnetic field tension is decreased by several percent

and this process continues for several hours (the main phase). At the end, during several days, the magnetic field gradually recovers and returns to its normal state [4].

The cosmic rays are observed on by the observatories in different areas of the Earth surface.

During Forbush decrease the intensities of the cosmic rays, like magnetic fields, start to reduce simultaneously and become less by several percent compared to usual, normal conditions. After the restoration of the magnetic field the cosmic ray intensity regains the value conformable to the normal state.

There arises a question: how can we explain a Forbush decrease? Usually, the tension in the magnetic field of the sun is several gausses. In the active solar area, where the flare takes place, the magnetic field is locally intensified. The solar magnetic field causes induction in the electric current of the ionized gas, which flows from the sun. Therefore, the gas becomes an electrical conductor. The current generated in it circulates during the time unless the gas leaves the sun. In their turn, the gases create magnetic field. The solar wind usually also creates a field in the interplanetary space. The plasma ejected during the solar flare, which moves in the direction of the shock wave, i.e., the front, creates a considerably intense field. This intense field forces the cosmic particles out of the solar system that produces a Forbush decrease effect. In case our assumption is correct then Forbush decrease must take place not only near the Earth but in the whole interplanetary space. Indeed, it has been proved by the analyses of the data obtained during spacecraft soundings in distant spaces [1].

The studies of Forbush effects have been actively carried out on the basis of the data of the neutron monitor of cosmic rays in order to analyze the physical processes taking place in the interplanetary space, the atmosphere and magnetosphere of the Earth. The Cosmophysical Observatory of Institute of Geophysics has been continuously recording the neutron component of the cosmic rays for decades [2].

At this stage we will touch the analysis of the data obtained during last 5 years (2014-2018, see Annex). During this time we revealed only 5 periods, when the Forbush decrease effect was clearly manifested. These periods are:

1. June 6-13, 2014;
2. May 20-26, 2015;
3. June 22-30, 2015;
4. July 16-22, 2017;
5. September 7-12, 2017.

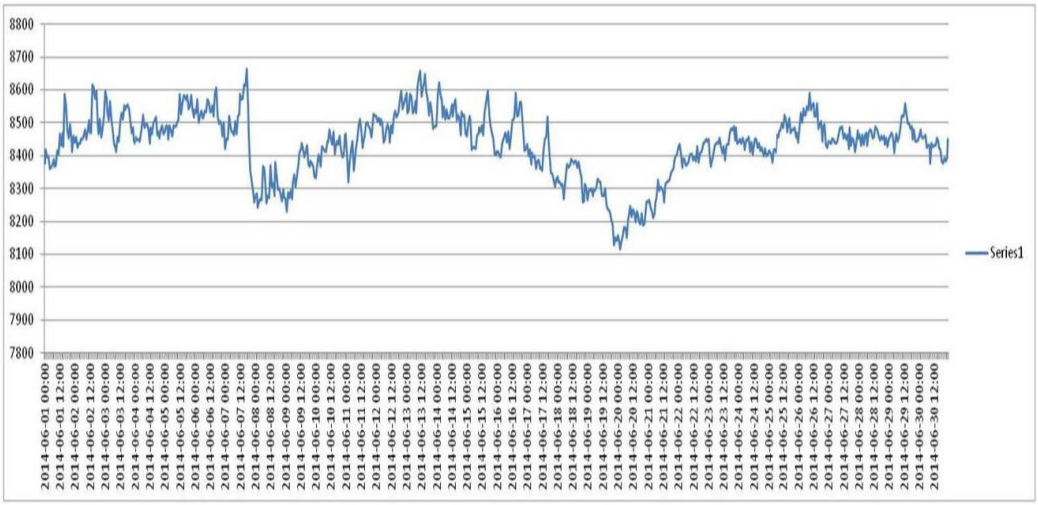
Correspondingly, we present the monthly schemes of all revealed Forbush effects in the article. They clearly show the periods when Forbush decrease effects took place. It will enhance carrying out further scientific researches.

The data of the above periods were compared to the similar neutron monitor data of Moscow and Irkutsk stations. The comparison results show that during the periods observed by us the Forbush decrease effects really took place. This means that during these periods there were solar flares of certain measures, the physical studies and analyses of which are the goals of further scientific researches.

Annex

Variations of intensity of neutron component of galactic cosmic rays
on June 2014, May and June 2015, July and September 2017

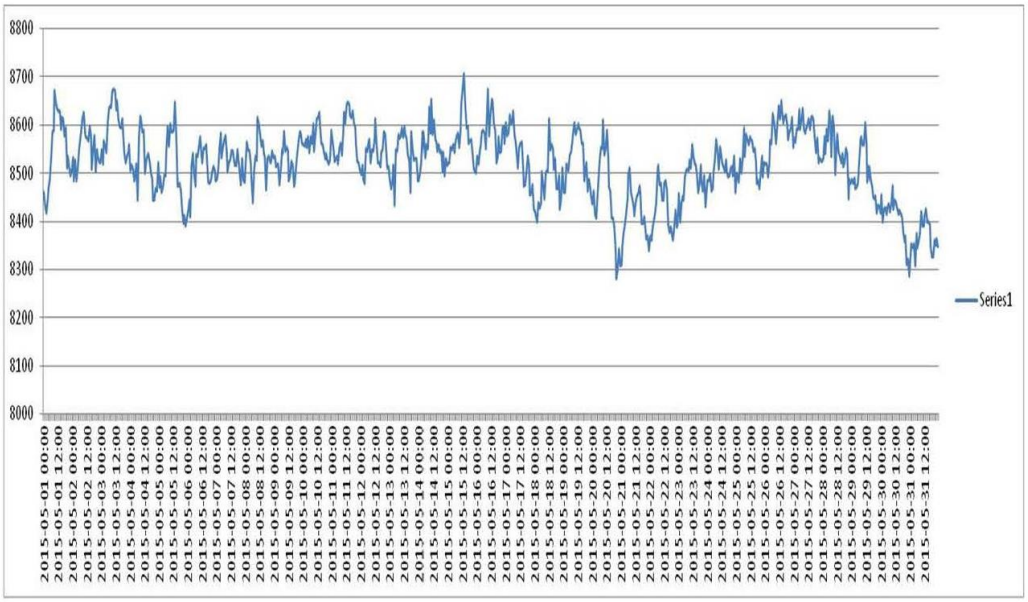
June, 2014



June 6-13, 2014

06.06.2014	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	8539	8531	8571	8503	8519	8535	8514	8518	8537	8534	8573	8561
	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	8532	8537	8551	8520	8592	8608	8519	8499	8505	8500	8460	8500
07.06.2014	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	8421	8451	8450	8520	8493	8475	8473	8462	8505	8466	8519	8528
	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	8586	8570	8574	8615	8612	8663	8548	8464	8357	8326	8299	8261
08.06.2014	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	8279	8285	8244	8260	8270	8265	8367	8361	8291	8255	8280	8272
	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	8370	8306	8317	8279	8379	8339	8297	8302	8282	8263	8297	8275
09.06.2014	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	8268	8231	8288	8272	8295	8270	8318	8343	8306	8340	8371	8412
	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	8418	8437	8422	8395	8413	8431	8375	8367	8383	8378	8368	8337
10.06.2014	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	8334	8375	8402	8395	8368	8428	8421	8416	8411	8445	8441	8479
	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	8453	8433	8473	8407	8436	8444	8436	8460	8420	8397	8399	8462
11.06.2014	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	8466	8402	8321	8384	8420	8444	8356	8374	8421	8448	8489	8511
	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	8480	8424	8441	8461	8499	8501	8490	8483	8458	8473	8528	8519
12.06.2014	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	8520	8504	8515	8494	8512	8502	8442	8451	8481	8494	8477	8440
	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	8491	8471	8517	8537	8517	8527	8533	8573	8597	8544	8559	8574
13.06.2014	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	8592	8529	8537	8586	8580	8530	8538	8565	8529	8610	8638	8659
	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	8580	8605	8626	8649	8593	8570	8524	8562	8533	8481	8489	8489

May, 2015



May 20-26, 2015

20.05.2015	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	8436	8462	8414	8408	8435	8482	8528	8553	8550	8611	8538	8552
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	8588	8531	8472	8464	8407	8406	8388	8341	8280	8300	8343	8307
21.05.2015	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
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	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	8438	8453	8458	8474	8459	8397	8396	8409	8380	8365	8369	8339
22.05.2015	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	8370	8361	8379	8398	8415	8439	8505	8517	8477	8480	8445	8445
	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	8478	8483	8465	8394	8378	8388	8377	8360	8388	8422	8389	8392
23.05.2015	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	8457	8399	8440	8451	8444	8492	8506	8509	8506	8526	8510	8559
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24.05.2015	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
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	8522	8513	8503	8526	8503	8492	8496	8512	8514	8495	8534	8460
25.05.2015	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	8500	8490	8482	8529	8501	8532	8594	8535	8580	8569	8558	8576
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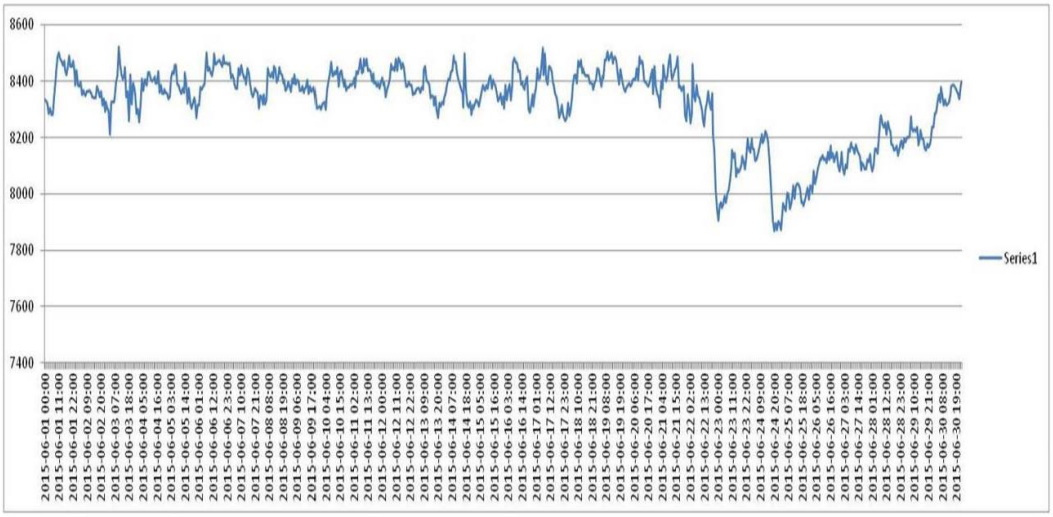
	8569	8567	8545	8550	8522	8479	8485	8469	8504	8534	8492	8522
26.05.2015	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	8519	8518	8491	8520	8566	8561	8623	8608	8579	8561	8601	8639
	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	8614	8649	8628	8605	8618	8621	8597	8571	8586	8591	8615	8553

June, 2015



June 22-30, 2015

22.06.2015	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
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	8268	8241	8299	8322	8364	8323	8302	8357	8214	8151	8016	7949
23.06.2015	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	7908	7962	7969	7951	7961	7991	7968	7999	8014	8049	8095	8155
	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	8130	8143	8061	8087	8079	8090	8107	8132	8113	8088	8135	8195
24.06.2015	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	8159	8149	8195	8163	8159	8120	8121	8142	8164	8189	8213	8183
	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	8192	8221	8211	8185	8120	8037	7990	7907	7869	7895	7873	7903
25.06.2015	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	7894	7874	7904	7965	7950	7940	8005	7998	7949	7965	7982	8030
	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	7983	8029	8036	8034	8017	7968	7972	7960	7976	7998	8021	7980
26.06.2015	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	8030	8021	8007	8080	8036	8058	8090	8106	8125	8124	8138	8122
	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	8125	8110	8147	8123	8172	8131	8144	8114	8134	8149	8100	8082
27.06.2015	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	8115	8148	8089	8072	8102	8093	8160	8151	8182	8168	8164	8144
	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	8174	8155	8144	8134	8086	8110	8104	8088	8088	8121	8113	8140
28.06.2015	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	8108	8082	8099	8161	8158	8145	8207	8271	8278	8248	8239	8253
	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	8210	8257	8232	8218	8179	8174	8154	8158	8170	8136	8159	8187
29.06.2015	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	8189	8165	8195	8187	8200	8199	8203	8276	8239	8221	8230	8221
	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	8239	8175	8200	8226	8196	8198	8164	8155	8177	8168	8177	8194
30.06.2015	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
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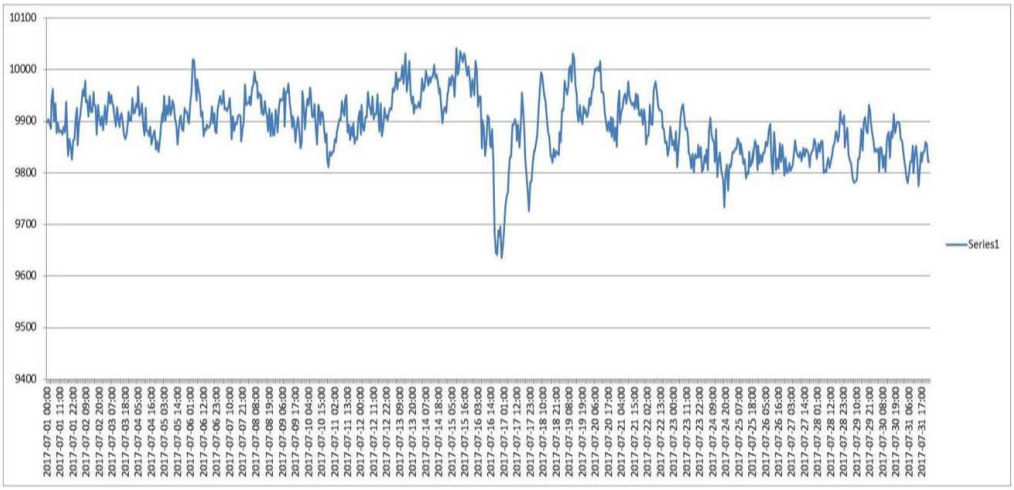
	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	8318	8326	8353	8384	8386	8387	8379	8366	8358	8338	8382	8398

July, 2017



July 16-22, 2017

16.07.2017	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
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	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	9906	9856	9849	9885	9824	9686	9646	9641	9689	9676	9695	9636
17.07.2017	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	9657	9692	9735	9756	9762	9795	9830	9832	9894	9893	9904	9892
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	9863	9894	9850	9887	9955	9918	9874	9832	9797	9765	9727	9782
18.07.2017	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	9784	9818	9842	9842	9857	9875	9920	9960	9994	9987	9972	9950
	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	9939	9907	9880	9868	9832	9833	9820	9847	9831	9842	9838	9835
19.07.2017	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
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	10022	9969	9954	9916	9899	9931	9903	9895	9929	9916	9923	9908
20.07.2017	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	9916	9945	9931	9960	9964	9984	10002	9999	10005	9998	10016	9957
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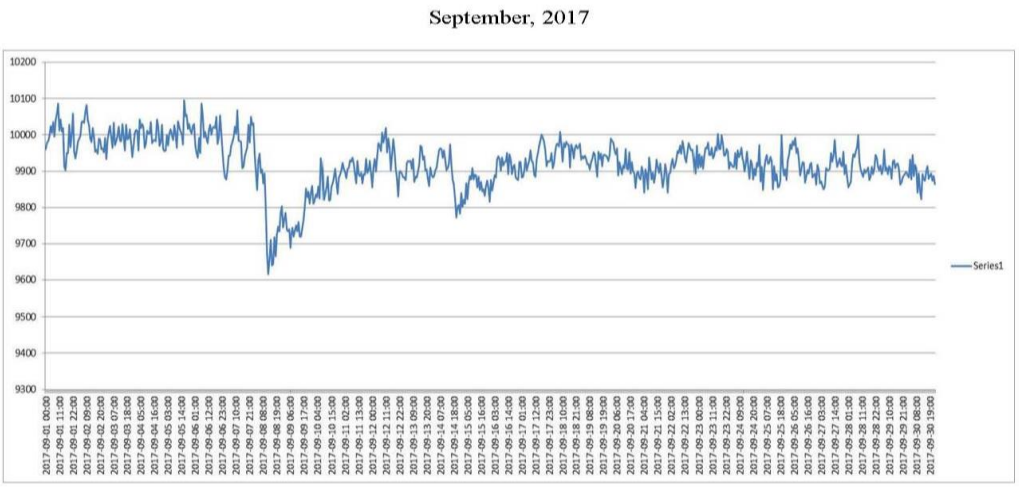
	9956	9953	9917	9900	9881	9900	9880	9908	9870	9905	9862	9887
21.07.2017	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	9851	9931	9959	9897	9918	9926	9946	9954	9935	9957	9977	9947
	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	9938	9931	9936	9924	9953	9926	9950	9912	9911	9922	9894	9922
22.07.2017	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	9895	9856	9872	9873	9931	9895	9894	9959	9966	9977	9955	9930
	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	9921	9921	9919	9888	9885	9858	9861	9834	9847	9889	9872	9854



September 7-12, 2017

07.09.2017	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
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	9985	9983	9981	9909	9911	9941	9954	9966	10028	9978	10050	10027
08.09.2017	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
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	9617	9657	9710	9640	9646	9717	9666	9725	9747	9734	9785	9803
09.09.2017	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	9745	9767	9785	9739	9735	9740	9689	9719	9743	9720	9736	9751
	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	9735	9760	9719	9720	9743	9765	9799	9852	9829	9843	9811	9842
10.09.2017	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	9859	9810	9820	9836	9828	9858	9824	9935	9901	9822	9838	9856
	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	9884	9819	9821	9858	9867	9885	9906	9870	9838	9883	9890	9903
11.09.2017	**0:00**	**1:00**	**2:00**	**3:00**	**4:00**	**5:00**	**6:00**	**7:00**	**8:00**	**9:00**	**10:00**	**11:00**
	9922	9907	9898	9881	9906	9908	9930	9927	9937	9920	9893	9866
	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	9928	9892	9886	9895	9866	9892	9890	9934	9896	9901	9929	9895
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	9855	9911	9934	9899	9940	9977	9972	9956	10006	9979	9996	10019
	12:00	**13:00**	**14:00**	**15:00**	**16:00**	**17:00**	**18:00**	**19:00**	**20:00**	**21:00**	**22:00**	**23:00**
	9951	9989	9965	9903	9946	9988	9956	9906	9879	9830	9900	9899

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[5] Amiranashvili A.G., Bakradze T.S., Ghlonti N.Ya., Khurodze T.V., Tuskia I.I. On the Connection Between Annual Variations of the Intensity of Galactic Cosmic Rays and the Changeability of Cloudiness and Air Temperature in Tbilisi. Journal of the Georgian Geophysical Society, Issue B. Physics of Atmosphere, Ocean and Space Plasma, v.19B, Tbilisi, 2016, pp. 128-134.

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ფორბუშ ეფექტების კვლევა მიხეილ ნოდიას სახ. გეოფიზიკის ინსტიტუტის კოსმოფიზიკურ ობსერვატორიაში, კოსმოსური სხივების ნეიტრონული კომპონენტის მონაცემების საფუძველზე

თ. ბაქრაძე, ი. ტუსკია, ნ. ღლონტი, ტ. ერქომაიშვილი,
ე. ალანია, ზ. ყვავაძე, პ. ბარბაქაძე

რეზიუმე

კოსმოსური სხივების მოდულაცია რთული პროცესია, რომელიც მოიცავს სხვადასხვა ფიზიკურ მოვლენებს მზე-დედამიწის არეში. გეოფიზიკის ინსტიტუტის კოსმოფიზიკურ ობსერვატორიაში უკვე რამოდენიმე ათეული წელია მიმდინარეობს კოსმოსური სხივების ნეიტრონული კომპონენტის უწყვეტი რეგისტრაცია. სტატიაში მოცემულია ჩვენს ობსერვატორიაში 2014-2018 წლების მონაცემებზე დაკვირვების, დამუშავებისა და ანალიზის საფუძველზე გამოვლენილი ფორბუშ დაცემის ეფექტის 5 შემთხვევა. აღნიშნული პერიოდის მონაცემები შედარებულია მოსკოვისა და ირკუცკის სადგურების მონაცემებთან, სადაც დაკვირვების შედეგად იგივე ფორბუშ ეფექტების არსებობა დადგინდა. ჩვენი აზრით, ყველაფერი ეს მიგვანიშნებს იმას, რომ მოცემულ პერიოდებში მზეზე მართლაც ჰქონდა ადგილი გარკვეული სიდიდს აალებებს. შესაბამისად ყოველი ცალკეული ფორბუშ ეფექტი საჭიროებს სამეცნიერო კვლევებს შემდგომი ანალიზის ჩასატარებლად.

Иследование эффекта Форбуша в космофизической обсерватории Института геофизики им. Михаила Нодиа по данным нейтронной компоненты космических лучей

**Т.С. Бакрадзе, И.И. Туския, Н.Я. Глоти, Т.Г. Эркомаишвили,
Э.М. Алания, З.А. Квавадзе, П.А. Барбакадзе**

Резюме

Процесс модуляции космического излучения представляет собой сложное явление, которое включает в себя различные физические события в солнечно-земной области. В космофизической обсерватории Института геофизики уже несколько десятилетий проводится непрерывная регистрация нейтронной компоненти космических лучей. В статье на основании анализа данных 2014-2018 гг. выявлено 5 случаев эффекта Форбуш понижения. Данные за этот период сопоставимы с данными Московской и Иркутской станций, где также наблюдались эффекты Форбуш понижения. На наш взгляд, это указывает на то, что в указанный период на Солнце происходила вспышка, что требует дальнейшего научного исследования и анализа.

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Chronicle

Information about Some International Scientific Events on 2019

Demuri I. Demetrashvili

M. Nodia Institute of Geophysics of I. Javakhishvili Tbilisi State University
e-mail: demetr_48@yahoo.com

ABSTRACT

There is given brief information on two International scientific events, conserning environmental problems and the Black Sea. An International Conference on GeoSciences GEOLINKS 2019 was held on 26-29 March 2019 in Athens (Greece) and An International Black Sea Maritime Security Symposium-2019 - on 27-28 June 2019 in Istanbul (Turkey).

Key words: conference, Black Sea, environment, security.

1. On 26-29 March 2019 **first International Conference on GeoSciences GEOLINKS 2019** was held in Athens (Greece) which aimed at giving a focus on the most important topics in the field of Geo Sciences (www.geolinks.info). Organizers and scientific partners of GEOLINKS-2019 were mainly Academies of Sciences in Eastern Europe, in particular, Slovak Academy of Sciences, Czech Academy of Sciences, National Academy of Sciences of Ukraine, Bulgarian Academy of Sciences, Polish Academy of Sciences, Academy of Sciences of Hungary, Serbian Academy of Sciences, Academy of Sciences of Moldova, Latvia Academy of Sciences. Among the organizers and scientific partners were alsoTurkish Academy of Sciences and Islamic World Academy of Sciences.

The specificity of the conference was that it was not focused on one area and its topic was very broad covering almost all areas related to the natural environment including Geology, exploration and mining, Soil Sciences, green architecture, air pollution and climate change, Ecology and Environmental Studies, Water Resources, *etc.*

There were 3 forms of participation in the conference: oral presentations, poster presentations, and virtual participation. A virtual conference participant could send an article for publication with the appropriate fee payment without going to the conference.

The conference was not numerous. In total about 75 reports were submitted. They included 18 oral presentations, 20 poster, and the other were virtual reports. The speakers were from the Czech Republic, Georgia, Kazakhstan, Kosovo, Latvia, Poland, Portugal, Romania, Russia, Slovakia, *etc.*

The presentations presented at the conference are published in three books, electronic versions of which are available on the Internet (https://issuu.com/geolinks5/docs/20190311_book_g1, https://issuu.com/geolinks5/docs/20190311_book_g2, https://issuu.com/geolinks5/docs/20190311_book_g3).

Among these presentations, some of them can be distinguished. The presentation "*Chronological analysis of contamination of the Russian territory by long-lived radionuclides*" by

authors E. Artyomov, E. Imshennik, A. Nakhutin from Yu. A. Izrael Institute of Global Climate and Ecology (Russian Federation) was devoted to the chronological categorization of the dry land contamination of the Russian territory with biologically significant long-lived radionuclides Cs^{137} and Sr^{90} based on the previously published scientific data [1]. The sources of radioactive contamination of the dry land territory were surface, underground and atmospheric tests of nuclear weapons, underground peaceful nuclear explosions, regular and accidental releases from nuclear industry objects and nuclear power plants, accidents with military equipment. Chronological analysis allowed identifying 5 main stages of contamination:

1. 1949-1953. From the start of operation of the nuclear industry and the first Soviet nuclear test to the beginning of global radioactive fallout.
2. 1953-1963. Until the end of the Soviet and American nuclear tests in the atmosphere.
3. 1963-1986. Period between the Moscow Treaty Banning Nuclear Weapon Tests in the Atmosphere,
   in Outer Space and Under Water and the Chernobyl accident.
4. 1986. The accident at the Chernobyl Nuclear Power Plant (NPP).
5. 1987 - present. The period after Chernobyl, post-Chernobyl small accidents.

The accident of April 26, 1986 at the Chernobyl NPP resulted in release into the environment of radionuclides, which far exceeded all radionuclides releases from previous accidents of atomic reactors. According to some estimations, the total release of radioactivity from the reactor by may 6, 1986 was about 50 MCi. Radioactive contamination after the Chernobyl accident affected vast territories. In addition to Belarus, Ukraine and Russia, significant contamination was observed in many European countries.

During the period after 1987 there were no events resulting in significant radioactive contamination of territories. The exception is the accident of April 6, 1993 at the Siberian Chemical Combine (Tomsk-7), which caused local contamination. At present, in the absence of major radiation accidents and other events, the density of contamination decreases at a rate approximately equal to the rate of radioactive decay, i. e. decreases twice in about 30 years for both Cs^{137} and Sr^{90}.

The goal of the presentation "*Numerical simulation of heat transfer in soil layer during forest fire in comparison with experimental data*" by N. Baranovsky, V. Maksimov, A. Razva, A. Bazarov from Tomsk Polytechnic University and Institute of Physical Material Science SB RAS (Russian Federation) was numerical simulation of heat transfer in the near-surface layer of the soil in case of forest fire [2]. It is well known that forest fires affect vegetation, atmosphere, living organisms and soils. In the last decades, forest fires have become a catastrophic phenomenon. An example of this is catastrophic fires in Siberian forests in Summer 2019 that covered several million hectares. Therefore, an important problem that needs to be solved is the development of mathematical models for assessing the effect of thermal conditions of forest fires on soil. The purpose of the study is a numerical investigation of the inert heat effect on the soil layer, taking into account experimental data, on the basis the simplest one-dimensional mathematical model. The solution area is represented by four layer: clay, organic layer, forest fuel layer and air above the forest fuel layer. The process of heat propagation in soil is described by a system of heat conduction equations with corresponding initial and boundary conditions. The verification of the mathematical model was carried out using experimental data obtained at a heater of 130^0C. Satisfied agreement was obtained between experimental data and numerical results for some scenarios.

The presentation "*High-resolving modeling and forecast of regional dynamic and transport processes in the easternmost Black Sea basin*" by D. Demetrashvili and V. Kukhalashvili from M.

Nodia Institute of Geophysics of I. Javakhishvili Tbilisi State University (Georgia) was devoted to the simulation and short-range forecast of the current, temperature and salinity fields as well as contamination distribution processes in the easternmost part of the Black Sea covering the Georgian Black Sea coastal zone and surrounding water area [3]. These studies are carried out on the basis of the coupled high-resolution Black Sea regional dynamics and transport models which are components of the regional forecasting system. By-turn this regional system is one of the parts of the Black Sea basin-scale Nowcasting/Forecasting System. All input data – the initial and prognostic hydrophysical (on the open boundary) and meteorological fields (at the sea surface) are provided from Marine Hydrophysical Institute (Sevastopol) in the near-operational mode. In the presentation some results of 3 days forecast of hydrophysical fields – the current, temperature and salinity with 1 km resolution for the easternmost part of the Black Sea are presented when forecasting period was 00:00 GMT, 25-28 August 2018. Comparison of predicted surface current field with the geostrophic current reconstructed with use of satellite altimeter data showed good agreement between these fields. In addition, in the presentation the sea surface temperature (SST) on 27 August 2018 and satellite SST derived from NOAA satellite for the same time moment are presented showing good agreement with each other. Nonstationary forecasted current field derived from the regional model of the Black Sea dynamics is used to simulate spatial-temporal distribution of polluting substances.

The aim of the presentation "*Assessment of the complex effects of hazardous waste components in aquatic ecosystems*" by S. Kvaterniuk, V. Pohrebennyk, R. Petruk, V. Petruk and A. Kochanek from Vinnytsia National Technical University (Ukraine), Lviv Polytechnic National University (Ukraine) and State Higher Technical School in Nowy Sacz (Poland) was to ensure environmental safety in the field of hazardous waste management and improve the efficiency of assessing their integrated impact on water bodies using methods and means of multispectral environmental monitoring [4]. The developed methods and tools were used for multispectral environmental measurement monitoring of the toxicity of hazardous components of solid household waste, which made it possible to increase the effectiveness of environmental monitoring of the environmental impact of landfills and waste-processing complexes.

In the presentation "*Arsenic accumulation, stress responses and tolerance in Agrostic castellana: phytoremediation potential of native flora* " by P. J. C. Favas from MARE-Marine and Environmental Science Centre, Faculty of Sciences and Technology of University of Coimbra (Portugal) the arsenic (As) contamination, stress responses, tolerance and phytoremediation potential of native flora of As-contaminated tailings in an abandoned mine (Northern Portugal) is evaluated [5].

Some presentations were devoted to investigation of some peculiarities of variability of geomagnetic field. In the presentation "*Statistical and spectral tools for analyzing of disturbance of geomagnetic field"* by Natalia-Silvia Asimopolos, A. A. Asimopolos and L. Asimopolos from Geological Institute of Bucharest and University POLITECHNICA of Bucharest (Romania) the wavelet and statistical analysis for the geomagnetic data recorded in the Geomagnetic Surlari Observatory with acquisition periodicity of 0,5 second to 1 minute are performed [6]. There are selected several recording periods in the cases of solar quiet day variations, solar disturbance daily variation and geomagnetic storm periods. The rapid sampling rate allowed authors to highlight micro pulsations and pulsations with periods of time between 2 seconds and 10 minutes. Also,

authors highlighted the continuous pulsations from classes Pc2, Pc3 and Pc4, as well as irregular pulsations from classes Pi1 and Pi2.

In the presentation "*Characterization of the geomagnetic field by analyzing the data recorded at the Surlari Geomagnetic Observatory*" by Natalia-Silvia Asimopolos, L. Asimopolos, B. Balea and A. A. Asimopolos from the same Institutions as in previous presentation the authors have described the steps to analyze the geomagnetic field's morphology. Based on data processing the gradients of each components are calculated, as well as, spectral, statistical and correlation analyzes [7]. All of these parameters are part of the geomagnetic database.

The presentation "*New industrialization's innovational impact on climate change*" by A. Agumbayeva and A. Yergalym from Saken Seifullin Kazakh agrotechnical University (Kazakhstan) and Collegium Civitas (Poland) discusses the role of the developing world in ensuring global environmental security, the links between industrialization and climate change are examined [8].

In the presentation "*GHG emission reduction in the agriculture of Latvia: the reality and opportunities* " by P. Rivza, D. Popluga, K. Naglis-Liepa, A. Lenerts and D. Kreismane from Latvia University of Life Sciences and Technologies (Latvia) is noted that at present in Latvia, agriculture is the second largest source of greenhouse gas (GHG) emissions, accounting for 24,2% of the total amount of GHG emissions in the country [9]. The presentation analyses 17 measures having GHG emission reduction potential by employing Marginal Abatement Cost Curves (MACC). The research resulted in constructing MACCs for five the most typical groups (clusters) of agricultural holdings.

The 2-nd GEOLINKS Conference will be held on March, 2020 in Plovdiv (Bulgaria).

2. On 27-28 June 2019 **first International Black Sea Maritime security Symposium-2019** (www.marseccoe.tsk.tr) was held in Istanbul (Turkey), which was organised by Multinational Maritime Security Centre of Excellence (MARSEC COE). The Symposium was held under the theme "*Maritime Security and Cooperation in the Black Sea***"**, which aimed to bring different stakeholders from academicians to military together and to cover general maritime issues free from regional disputes. Presentations covered the following main topics:

1. The Black Sea from Historical Perspective
2. Montreux Convention and Sea of Peace: "The Black Sea"
3. Overview of the Black Sea Economy
4. The Black Sea Energy Routes and their Effects over Maritime Transport
5. Climate Change and Maritime Trade Relationship: It's Effect over the Black Sea
6. Oceanography of the Black Sea
7. Fighting Against Maritime Pollution in the Black Sea
8. Analysis of Maritime Accidents in the Black Sea and Search & Rescue.

About 15 people were invited to participate in the symposium as a guest speakers, most of them were from Turkish Institutions, and other were from Bulgaria, Georgia, Netherlands, Russia. In addition, it should be noted that the highest military representatives of the Turkish naval forces participated in the Symposium. We will give a brief overview of some of the presentations.

The presentation "*Montreux Convention and Sea of Peace: "The Black Sea" (Turkish Perspective)*" by M. Celikpala (Turkey) concerned political aspects connected to 1936 Montreux Convention, which regulates the transit of warships through the Turkish Straits and guarantees the freedom of passage of civilian vessels in times of peace and war [10]. The Convention gives Turkey

full control over the Turkish Straits, guarantees the free passage of civilian vessels in peacetime. The Convention makes a clear differentiation between the Black Sea littorals, i. e. Turkey, Bulgaria, Romania, Ukraine, Russia and Georgia and non-littorals. From Ankara's perspective, the Convention is understood as one of the most important achievement in Turkey's recent political history and playd a major role in keeping the Black Sea region out of the NATO-Warsaw Pact confrontation throughout the Cold War era.

The presentation "*NATO Strategic Communication on the Access to the Black Sea*" by M. Meijer (Turkey) describes how NATO strategic communication exploits the Montreux Convention as a good practice of international law [11]. It also describes the good practice of management of incidents at sea in order to prevent international conflicts. It is concluded that international law, like the Montreux Convention, does prevent escalation of maritime incidents into international conflicts. Therefore it is recommended to create similar conventions to safeguard free access to the Black Sea for merchant shipping and naval vessels coming from the Sea of Azov via the Kerch Strait.

In the presentation "*Overview of the Black Sea Economy*" by H. I. Karabiyik (Turkey) is noted that The Black Sea has a strategic location connecting Balkans, Europe, Anatolia, and the Caucasus region with the contribution of maritime and energy crossroads [12]. In addition, it holds one of the world's largest known reserves of gas and oil and about 16 million people inhabit the coastal area. The Black Sea has over 20 big commercial ports, of which half of them can handle large commercial vessels. Huge investment projects are ongoing such as Anaklia in Georgia and Marmara region. New opened Baku Tiflis Kars railway, Marmaray which is undergoing the Istanbul strait and 3 bridge railway sections are increasing the potential usage of multimodal transport and inland surface connections of the Black Sea. .

In the presentation "*Operational forecasting hydrodynamic processes and pollutant transport in the easternmost part of the Black Sea*" by D. Demetrashvili (Georgia) some results of simulation and forecast of dynamic fields and propagation of polluting substances in the Georgian coastal zone and surrounding area were demonstrated on the basis of the Black Sea regional forecasting system, which is one of the parts of the Black Sea basin-scale Nowcasting/ Forecasting System [13]. It is noted that through the Black Sea (including Georgian sector of the sea) passes an international transport corridor TRACECA (Transport corridor Europe-Caucasus-Asia) and in the coming years more intensive shipping is expected. It is obvious that in conditions of growing intensity of shipping and, accordingly, more significant anthropogenic load on the marine environment, operation of the Black Sea forecasting system providing forecast of main hydrophysical parameters is very relevant and important for environmental and navigation security.

The presentation "*Black Sea Commission: Fighting against Maritime Pollution in the Black Sea*" by Ir. Makarenko (Black Sea Commission's Permanent Secretariat, Istanbul/Turkey) was devoted to international efforts and activities to protect the Black Sea from pollution [14]. Nowadays, the Convection on the Protection of the Black Sea Against Pollution, also known as Bucharest Convention, is one of the most known Regional Sea Conventions and instruments of the International Environmental Law, which was signed and ratified in 1992 and 1994, accordingly, and provided the legal ground for combating pollution from land-based sources and maritime transport, achieving sustainable management of marine living resources and sustainable human development in the Black Sea region. The Black Sea Commission's activities and exercise program is an integral part of the regional preparedness framework and enables countries around the Black Sea to cooperate and coordinate efforts in case of major oil pollution incidents.

The presentation "*Oceanography of the Black Sea*" by S. Besiktepe (Turkey) gives a brief overview of development of the Black Sea Oceanography [15]. It is noted that studies to understand the oceanography of the Black Sea started in the beginning of the 1900s and carried out through the efforts in the former USSR and other countries. In the beginning of the 1990s, increased international cooperation among the riparian countries allowed carrying out more systematic basin wide surveys. The basin-wide surveys, HydroBlack91 and CoMSBlack92, were completed by several ships in about one month. These collaborations were started within the context of the NATO TU-Fisheries program and then continued through the CoMSBlack international program, NATO-TU Black Sea project and NATO-ODBMS project, respectively. These studies provide an initial coherent description of the basin and sub-basin circulation and its variability and proved the schematic circulation.

Symposium proceedings book will be published. The second Black Sea Maritime Security Symposium will be held in 2020 in Istanbul.

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ინფორმაცია 2019 წ. ზოგიერთი საერთაშორისო სამეცნიერო ღონისძიებების შესახებ

დ. დემეტრაშვილი

რეზიუმე

მოცემულია მოკლე ინფორმაცია ორი საერთაშორისო სამეცნიერო ღონისძიების შესახებ, რომლებიც შეეხება გარემოს ეკოლოგიის საკითხებსა და შავ ზღვას. საერთაშორისო კონფერენცია გეო - მეცნიერებათა შესახებ (GEOLINKS-2019) გაიმართა 2019 წლის 26-29 მარტს ქ. ათენში (საბერძნეთი), ხოლო შავი ზღვის საზღვაო უსაფრთხოების სიმპოზიუმი - ქ. სტამბულში (თურქეთი) 2019 წლის 27-28 ივნისს.

Информация о некоторых международных научных мероприятиях в 2019 г.

Д. И. Деметрашвили

Резюме

Дается краткая информация о двух международных научных мероприятиях, посвященных проблемам окружающей среды и Черного моря. Международная конференция по Геонаукам GEOLINKS 2019 состоялась 26-29 марта 2019 года в Афинах (Греция), а Международный симпозиум по морской безопасности Черного моря - 27-28 июня 2019 года в Стамбуле (Турция).

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To the Memories of Bakur Beritashvili (1940-2019)

Naili I. Kapanadze

Institute of Hydrometeorology of Georgian Technical University
knaili1990@gmail.com

ABSTRACT

The biographical information about Bakur Beritashvili - prominent geophysicist, Main Scientific Worker of Weather forecast, natural and technogenic disaster modeling department of Institute of Hydrometeorology of Georgian Technical University, Doctor of Geographycal Sciences is presented

Key words: Cloud physics, weather modification, precipitation artificial growth, climate change.

Bakur Beritashvili

Bakur Beritashvili was born on September 22, 1940 in Tbilisi, in the family of famous artist Shalva Beritashvili and the unrivaled specialist of foreign languages - Lydia Modzelevskaya. In 1958, after finishing school with Gold Medal, he continued studies at the Faculty of Physics at Tbilisi State University, which graduated in 1964 with the specialty of geophysics. In 1963 he was sent to Leningrad, the Main Geophysical Observatory (MGO) to complete diploma works, where he continued studies in absentia as postgraduate student until 1969. By the end of 1963, the enviable student was enrolled in the stuff of the Institute of Hydrometeorology at the Junior Science Worker position.

Since 1966 B. Beritashvili was assigned to manage meteorological and agro meteorological works on Paravani polygon.

In 1971-1973 he was appointed as the head of the Sevani Expedition of the Institute of Hydrometeorology, which under union program explored the possibility of precipitation artificial growth in the Lake of Sevani.

At the beginning of 1971 Mr. Bakuri defended the Candidate Thesis to acquire scientific degree in physics and mathematics at MGO. In Candidate Thesis the results of the work carried out by him in order to study the dynamics of clouds on the Paravani polygon were summarized.

In 1975-1976 B.Beritashvili continued his career at M. Nadia Institute of Geophysics of Georgian Academy of Sciences. In the Institute of Geophysics, under his guidance, the plan of creation of a complex geophysical polygon of Javakheti was prepared.

In 1977-1978 he returned to the Institute of Hydrometeorology and by Acad. G. Svanidze's order headed precipitation artificial increasing works in Iori river basin. He prepared the scientific-technical justification of the project "Iori", which was the basis for the precipitation artificial

increasing work carried out till 1992 in the mentioned region which was most important for the different fields of economy.

In 1978 B.Beritashvili was invited to the state investigation commission on the activities of the fight against hail and year later he moved to work at Telavi to participate in the practical work on weather modification, where at Gogebashvili Pedagogical Institute he was reading lectures in parallel..

Since 1987 B.Beritashvili returned to the Institute of Hydrometeorology and continued the scientific-methodical leadership of the works of the Iori polygon and other regions of eastern Georgia to increase precipitation. Mr. Bakuri has accomplished his work in the mentioned field by defending Doctoral Thesis at the Tbilisi State University in 1994.

Since 1995 B.Beritashvili is the deputy director of the Institute of Hydrometeorology at the scientific field. He was overseeing 4 laboratories in the ecology department, acting as Deputy Editor at the Institute's Editorial Board and was responsible for editorial controls of the dissertation theses prepared by the Institute's staff.

At the institute B. Beritashvili led the development of cloud and precipitation field monitoring system, as well as actively participating in various projects implemented by the Institute. In the same period (since 1995) his interests have moved to climate change problems. He was appointed at the position of deputy coordinator of the National Program for Climate Change and in 1997-2015 with the support of UNDP by his immediate participation, the First, Second and Third National Communication of Georgia to the United Nations Framework Convention on Climate Change was prepared. He was the dozens of project participants, headed for vulnerability and adaptation groups, and he was tasked with editing papers and projects. With his active participation the project was carried out by the European Commission to implement the "Clean Mechanism."

Since 2006 B. Beritashvili was the Main Scientific Worker of the Institute of Hydrometeorology, by his initiative the numerous researches were carried out used during the implementation of various project related to climate change.

He has published more than 100 scientific works, including 5 monographs, 3 manuals, brief explanatory dictionary related to climate change, brief histories of the Main Geophysical Observatory of Tbilisi and Institute of Hydrometeorology founded on its base.

Under his guidance 5 doctoral theses were performed. In 2001 he was awarded with the Order of Honor.

Widespread erudition, brilliant knowledge of languages, hard work, high performing culture, humility, communication and collegiality created the name of one of the leading scholars of the Institute for Mr. Bakuri, and conditioned high authority among colleagues. He served faithfully his beloved work until the last minute of his life. It also indicates that the day before his death he finished his sixth monograph.

In the person of Mr. Bakuri, the Georgian geophysicists lost noticeable scientist and teacher, man with high intellect and a culture whose path and scientific work is a sample of how to live and work to remain forever in the memory of family, colleagues and friends. Mr. Bakuri has left a rich scientific heritage, which will greatly serve future generations.

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ბაკურ ბერიტაშვილის ხსოვნისათვის (1940-2019)

ნ. კაპანაძე

რეზიუმე

წარმოდგენილია ბიოგრაფიული ინფორმაცია ბაკურ ბერიტაშვილის შესახებ, ცნობილი გეოფიზიკოსი, საქართველოს ტექნიკური უნივერსიტეტის ჰიდრომეტეოროლოგიის ინსტიტუტის ამინდის პროგნოზის, ბუნებრივი და ტექნოგენური კატასტროფების მოდელირების დეპარტამენტის მთავარი მეცნიერ-თანამშრომელი, გეოგრაფიის მეცნიერებათა დოქტორი

В память о Бакуре Бериташвили (1940-2019)

Н.И. Капанадзе

Резюме

Представлена биографическая информация о Бакуре Бериташвили - видном геофизике, главном научном сотруднике отдела моделирования прогнозирования погоды, природных и техногенных катастроф Института гидрометеорологии Грузинского технического университета, доктора географических наук.

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