SCIENTIFIC RESEARCH OF THE SCO COUNTRIES: SYNERGY AND INTEGRATION

上合组织国家的科学研究：协同和一体化

Proceedings of the International Conference

Date: October 28

Beijing, China 2020

上合组织国家的科学研究：协同和一体化国际会议

参与者的英文报告

International Conference “Scientific research of the SCO countries: synergy and integration”

Part 2: Participants’ reports in English

2020年10月28日。中国北京
October 28, 2020. Beijing, PRC

Proceedings of the International Conference **“Scientific research of the SCO countries: synergy and integration”**. Part 2 - Reports in English

(October 28, 2020. Beijing, PRC)

ISBN 978-5-905695-74-4

这些会议文集结合了会议的材料 – 研究论文和科学工作者的论文报告。 它考察了职业化人格的技术和社会学问题。一些文章涉及人格职业化研究问题的理论和方法论方法和原则。
作者对所引用的出版物，事实，数字，引用，统计数据，专有名称和其他信息的准确性负责

These Conference Proceedings combine materials of the conference – research papers and thesis reports of scientific workers. They examines tecnical and sociological issues of research issues. Some articles deal with theoretical and methodological approaches and principles of research questions of personality professionalization.

Authors are responsible for the accuracy of cited publications, facts, figures, quotations, statistics, proper names and other information.

ISBN 978-5-905695-74-4

CONTENTS

ECONOMICS

贝加尔湖旅游业发展的问题和前景
Problems and prospects of tourism development on Lake Baikal
Mariia A. Balashova, Viktor K. Kropochev, Alexander M. Balashov.....11

PHILOSOPHICAL SCIENCES

集合的数学概念是一致性的极其抽象的概念（某些辩证矛盾的极点）
The mathematical concept of a set as an extremely abstracted concept of consistency (poles of a certain dialectical contradiction)
Shipovskaya Lyudmila Pavlovna.....20

PHILOLOGY

俄语交流中冲突的语言标记
Language markers of conflict in Russian communication
Gilazova Dilyara Rifovna, Popova Valentina Nikolayevna.....25

语言手段在冲突交流中的作用分析
The analysis of the role of linguistic means in conflict communication
Kulyeva Aigoul Albertovna.....30

“白话”在俄语语言学中的定义
Definition of «vernacular» in Russian linguistics
Potanina Olga Yurievna, Fomina Olga Anatolievna.....34

SOCIOLOGICAL SCIENCES

数字自闭症是新一代发展的破坏性因素
Digital autism as a destructive factor for the development of new generations
Dryaev Maxim Ruslanovich, Kurenevskii Aleksey Sergeevich, Trukhanovich Darya Sergeyevna.....39

HISTORICAL SCIENCES

关于社会主义的范畴
About category of socialism
Ikhlov Boris Lazarevitch.....43

30年代和40年代苏联的历史唯物主义
Historical materialism in the USSR in the 30s and 40s
Ikhlov Boris Lazarevitch.....51

POLITICAL SCIENCES

心态是形成政治人物形象的重要因素
Mentality as important factor in forming the politician's image
Karnaukhova Marina Vladimirovna, Talina Irina Vladimirovna, Karnaukhov Vladimir Anatolyevich.....65

MEDICAL SCIENCES

支气管哮喘患儿间歇性低压室低氧低氧刺激后P物质的变化
Dynamics of substance P after intermittent barochamber hypobaric hypoxic stimulation in children with bronchial asthma
Alemanova Galina Dmitrievna, Popova Larisa Yuryevna, Vivtanenko Tatiana Vladimirovna, Volyanik Olga Vladimirovna.....71

使用最佳咬合面构建方法对正畸治疗结果进行定量评估
Quantitative evaluation of the results of orthodontic treatment using the method of constructing the optimal occlusal plane
Fadeev Roman Aleksandrovich, Lanina Anastasiia Nikolaevna, Timchenko Vladimir Vladimirovich.....77

麻疹患者止血参数的变化
Changes in some parameters of hemostasis in patients with measles
Lazareva Elena Nikolaevna, Aleshina Nina Igorevna, Astrina Olga Semyonovna, Navruzova Luiza Narimanovna.....88

过敏性疾病和幽门螺杆菌感染
Allergic diseases and Helicobacter pylori infection
Mazurina Svetlana Alexandrovna, Gervazieva Valentina Borisovna, Sveranovskaya Valeriya Veniaminovna.....92

中年人锂缺乏症的认知功能障碍
Cognitive dysfunction in lithium deficiency in middle-aged individuals
Pepelyaev Evgeny Gennadievich, Semenov Vladimir Alexandrovich, Gromova Olga Alekseevna.....99

喀山患者慢性自发性荨麻疹的临床和致病性变异
Clinical and pathogenetic variants of chronic spontaneous urticaria in patients of Kazan
Sibgatullina Nailya Askhatovna, Delian Victoria Yurievna, Mazurina Svetlana Alexandrovna.....104

PHARMACEUTICAL SCIENCES

研究基于2-苯基-9-二乙基氨基乙基咪唑并[1,2-A]苯并咪唑的硝酸硝酸盐的片剂剂型对兔的慢性毒性作用
To study the cardiotoxic effect of a tablet dosage form based on 2-phenyl-9-diethylaminoethylimidazo[1,2-A]benzimidazole dinitrate in rabbits under conditions of chronic toxicity
Domanina Angelina Mikhailovna, Chernikov Maxim Valentinovich.....111

咪唑并[1,2-a]苯并咪唑-9-（2-二乙基氨基乙基）-2-苯基咪唑并[1,2-a]苯并咪唑二硝酸盐的光谱分析方法
Methods of spectroscopic analysis of imidazo [1,2-a] benzimidazole - 9-(2-diethylaminoethyl) -2-phenylimidazo [1,2-a] benzimidazole dinitrate
Mitrakova Darya Olegovna, Remezova Irina Petrovna, Morozov Andrey Vladimirovich.....117

CHEMICAL SCIENCES

含硼生物活性玻璃：制备和性能
Boron-containing bioactive glasses: preparation and properties
Grishchenko Dina Nikolaevna, Medkov Mihail Azarievich.....123

放射性核素清洁土壤的过程
Processes of soil cleaning from radionuclides
Mammadov Khagani Farzulla oglu, Shiraliyeva Hajar Nuhbala qizi.....130

TECHNICAL SCIENCES

测试车载电子设备的温度影响
Testing on-board electronic equipment for temperature effects
Bykov Alexey Petrovich, Denisyuk Alina Alekseevna.....139

无线电电子手段质量和可靠性的预测算法和程序
Algorithm and program for forecasting quality and reliability of radio electronic means
Denisyuk Alina Alekseevna, Bykov Alexey Petrovich, Piganov Mikhail Nikolaevich.....144

冬季使用电缆系统和太阳能电池板在人行道上行人安全
Traffic safety ensurance on a pedestrian sidewalks in winter conditions using a cable system and solar panels
Rogulina Darya Aleksandrovna, Panina Ksenia Sergeevna, Burgonutdinov Albert Masgutovich.....152

使用蒙特卡洛方法开发一种用于估计接收和发送信号而没有失真的概率的算法
Development of an algorithm for estimating the probability of receiving and transmitting a signal without distortion using the Monte Carlo method
Saidov Behruz Badridinlovich, Telezhkin Vladimir Fedorovich.....158

比较文本原创性以处理窃隐藏技术的系统
Comparison of the systems for checking the originality of texts to process plagiarism hiding techniques
Sharapova Ekaterina Viktorovna.....165

具有调制kharakteristicheskaya函数的信号的Gladdie衰落的信道中调制解调器的研究
Study of a modem in a channel with gladkie fading of signal with modulated kharakteristicheskaya function
Veshkurtsev Yury Mikhaylovich.....171

PHYSICS AND MATHEMATICS

对哈勃定律的解释
To interpretation of Hubble law
Ikhlov Boris Lazarevitch.....179

使用计算机视觉系统进行变形和位移的光学计量
Use of computer vision systems for optical metrology of deformations and displacements
Plykina Ekaterina Victorovna.....187

EARTH SCIENCES

制定区域农业部门适应气候变化的适应计划：任务，解决方案，所用信息
Development of adaptation plan for the regional agricultural sector to climate change: tasks, solutions, information used
Ashabokov Boris Azretalievich.....194

创建评估模型以选择地下浸出垫的最佳位置
Creating a rating model to select the optimal location underground leaching pads
Goncharov Denis Sergeevich, Razmakhnin Konstantin Konstantinovich, Razmakhnina Irina Borisovna.....203

北高加索联邦区当前气候变化评估
Assessment of current climate change in the North Caucasian Federal District
Kesheva Lara Asirovna, Teunova Nataliya Vyacheslavovna.....212

萨哈共和国（雅库特）的工程地质学地带划分方法
Approaches to Engineering Geocryological Zonation of the Republic of Sakha (Yakutia)
Shestakova Alyona Alexeevna.....220

过去60年俄罗斯南部季节性降水的回归分析结果
Results of regression analysis of seasonal precipitation in southern Russia over the past 60 years
Tashilova Alla Amarbievna.....229

2020–2029年北高加索地区平坦区的季节性温度预测
Forecast of seasonal temperatures in the flat zone of the North Caucasus region for 2020-2029
Teunova Nataliya Vyacheslavovna, Kesheva Lara Asirovna.....238

Foreword

We thank all participants of our conference "Scientific research of the SCO countries: synergy and integration" for the interest shown, for your speeches and reports. Such a wide range of participants, representing all the countries that are members of the Shanghai Cooperation Organization, speaks about the necessity and importance of this event. The reports of the participants cover a wide range of topical scientific problems and our joint interaction will contribute to the further development of both theoretical and applied modern scientific research by scientists from different countries. The result of the conference was the participation of 56 authors from 7 countries (China, Russia, Uzbekistan, Kazakhstan, Azerbaijan, Tajikistan, Kyrgyzstan).

This conference was a result of the serious interest of the world academic community, the state authorities of China and the Chinese Communist Party to preserve and strengthen international cooperation in the field of science. We also thank our Russian partner Infinity Publishing House for assistance in organizing the conference, preparing and publishing the conference proceedings in Chinese Part and English Part.

I hope that the collection of this conference will be useful to a wide range of readers. It will help to consider issues, that would interest the public, under a new point of view. It will also allow to find contacts among scientists of common interests.

Fan Fukuan,
Chairman of the organizing committee of the conference
"Scientific research of the SCO countries: synergy and integration"
Full Professor, Doctor of Economic Sciences

前言

我们感谢所有参加本次会议的“上海合作组织国家的科学研究：协同作用和整合”，感谢您的演讲和报告。代表所有上海合作组织成员国的广泛参与者都谈到此次活动的必要性和重要性。参与者的报告涵盖了广泛的主题性科学问题，我们的联合互动将有助于不同国家的科学家进一步发展理论和应用的现代科学研究。会议结果是来自7个国家（中国，俄罗斯，乌兹别克斯坦，哈萨克斯坦，阿塞拜疆，塔吉克斯坦，吉尔吉斯斯坦）的83位作者的参与。

这次会议的召开，是学术界，中国国家权力机关和中国共产党对维护和加强科学领域国际合作的高度重视的结果。我们还要感谢我们的俄罗斯合作伙伴无限出版社协助组织会议，准备和发布中英文会议文集。

我希望会议的收集对广大读者有用，将有助于在新的观点下为读者提供有趣的问题，并且还将允许在共同利益的科学家中寻找联系。

范福宽，
教授，经济科学博士，中国科学院院士，会议组委会主席“上合组织国家科学研究：协同与融合”

DOI 10.34660/INF.2020.22.23.001

贝加尔湖旅游业发展的问题和前景
PROBLEMS AND PROSPECTS OF TOURISM DEVELOPMENT ON LAKE BAIKAL

Mariia A. Balashova
Candidate of Economic Sciences, Associate Professor
Baikal State University
Viktor K. Kropochev
Student
Baikal State University
Alexander M. Balashov
Student
Baikal State University

抽象。当前，旅游业是世界发达国家和发展中国家经济结构中最重要的产业之一。如果一个及时建立的行业基础设施能够满足二十一世纪的具体情况，有力的立法，充足的预算拨款，选择促进相关服务的最佳模式，那么旅游业可以为这两个领域的发展做出贡献。微观和宏观经济实体。不幸的是，无论是对于现代的俄罗斯，还是对于整个俄罗斯，还是对于个别地区，该规则都尚未生效。尤其是伊尔库茨克地区，尽管流量不断增加，但在世界上贝加尔湖所独有的伊尔库茨克地区仍不能归因于世界吸引游客的中心。为了解决该地区旅游业发展中存在的问题，本文考虑了作者在贝加尔湖上的旅游发展概念。

关键字。旅游业，该地区的旅游业发展问题，伊尔库茨克州贝加尔湖。

Abstract. *Currently, the tourism industry is one of the most important in the structure of the economies of both developed and developing countries of the world. In the case of a timely created infrastructure base of the industry that meets the specifics of the XXI century, competent legislation, sufficient budgetary provision, the choice of the optimal model for promoting the relevant services, the tourism industry can contribute to the enrichment of both micro and macro-economic entities. Unfortunately, both for modern Russia, in general, and for its individual regions, this rule does not work yet. In particular, the Irkutsk region, on whose territory the unique in the world Lake Baikal is located, despite the increase in the flow, cannot yet be attributed to the world center of attraction for tourists. In order to level the existing problems of the development of the tourism industry*

in the region, the article considers the author's Concept of tourism development on Lake Baikal.

Keywords. *Tourism, problems of tourism development in the region, Irkutsk Oblast, Lake Baikal.*

As practice shows, globalization, liberalization, integration, as well as the development of diplomatic relations between countries have become a trigger for the active development of the world tourism industry. For the period from 1980 to 2018, the percentage of the world's population that required an entry visa to visit foreign destinations fell from 75% to 53%, respectively, and the frequency of tourist travel increased from 50 to 56%[1].

At present, tourism has been reasonably attributed to one of the fastest growing sectors of the economy in the world, which is second only to industry in terms of volume and efficiency. Even so, it is well ahead of such important industries as financial services, healthcare or science. In such countries of the Organization for Economic Co-operation and Development (OECD) as Spain, France and Portugal, tourism today accounts for 15%, 7.3% and 13.7% of gross domestic product (GDP), respectively.

According to the latest figures released by the World Travel and Tourism Council (WTTC), the tourism industry currently accounts for 10.4% of global GDP, making it one of the largest economic sectors in the world (8.8 trillion dollars). As of 2018, the industry employed 319 million people and is expected to reach 421 million by 2029.

The Russian Federation has a high tourism potential. The natural and climatic diversity of Russian regions makes it possible to develop almost all types of tourism in the country, such as beach, cultural, educational, cruise, ecological, rural, active, adventure, and health tourism. According to the World Tourism Organization (UNWTO), we can reasonably receive up to 40 million foreign tourists a year (which is comparable to Turkey's indicators). However, at present this figure is only 24.4 million people, which in the country structure of the world tourism market gives our country only 1%. In other words, in terms of natural and cultural tourism potential, Russia ranks fifth in the world, but in terms of competitiveness it is at the bottom of the list, which currently determines its status - not an exporter, but an importer of world tourism services. Against this background, the predominance of the outbound tourist flow over the inbound one is quite natural. At the same time, over the past five years, there has been a positive growth of the former (the total departure of Russians abroad in 2019 amounted to 45.3 million trips, which is 43% more than in 2016) (fig. 1). The countries leading the "attraction" of

[1]The Travel & Tourism Competitiveness Report 2019 [Electronic resource] // http://www3.weforum.org/docs/WEF_TTCR_2019.pdf URL: (access 12.10.2020)

Russian tourists include Turkey (15% of the total number of trips), Ukraine (6%), Italy (5%), Thailand (5%) and Kazakhstan (5%).

As for inbound tourism, we are of primary interest to citizens of the post-Soviet republics, as well as tourists from China. Of particular concern in this case is the average negative dynamics of visits (tab. 1).

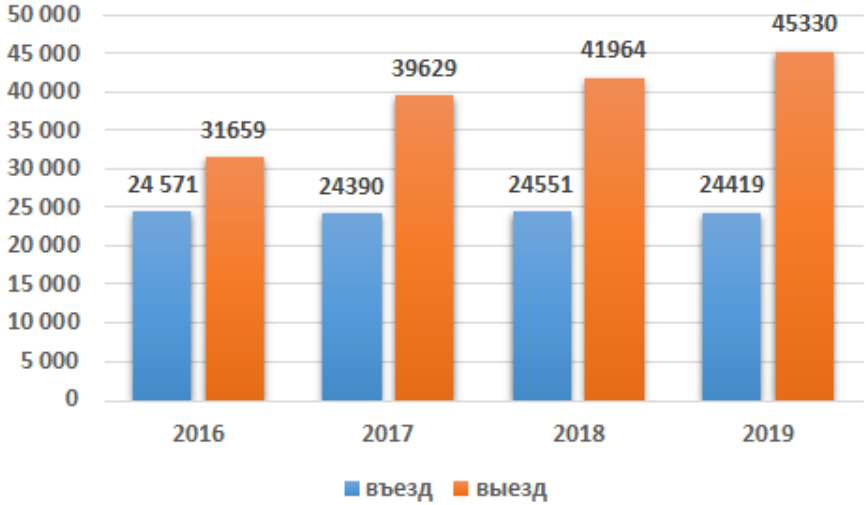


Fig. 1. *Dynamics of entries to Russia and departures of Russian citizens for tourism purposes, thousand people*

Table 1

The number of tourist trips of foreign citizens to Russia in 2018-2019, thousand people

Country	2018	2019	Change, %
1. Ukraine	8 202	7760	-5
2. Kazakhstan	3 510	3564	1,5
3. China	1 690	1883	11
4. Azerbaijan	893	911	2
5. Finland	950	896	-6
6. Germany	645	690	7
7. Poland	682	641	-6
8. Abkhazia	488	596	22
9. Armenia	566	551	-3
10. Estonia	478	523	9

Total for top 10 countries	18 104	18 015	-0,49
Total for all countries	24 551	24 419	-0,5

Note: compiled by the authors on the basis of summarizing sources [Official site of the federal agency for tourism [Electronic resource] // Tourism.gov.ru. — Access: https://tourism.gov.ru/contents/statistika/ (appeal date: 12.10.2020)]

The main Russian centers of attraction for both foreign tourists and citizens of our country are:

- in the direction of recreation and entertainment - the Crimea peninsula, Lake Baikal, Krasnodar and Altai Krais, St. Petersburg;
- in the segment of sports trips - Sochi, Altai and Krasnodar Krai, Dombai Mountains and the Caucasus;
- in the niche "health restoration" (preventive treatment) - the resorts of the Caucasus (Mineralnye Vody), the resorts of the Crimean peninsula, Kislovodsk, Moscow, Krasnodar Krai;
- in the direction of cultural enrichment - St. Petersburg, Moscow, Golden Ring, Kazan, the Crimean peninsula, etc.

In our opinion, there is nothing surprising in the fact that Krasnodar Krai and Crimea, in particular, occupy a leading position in terms of the number of people wishing to visit these places for different purposes. This is facilitated by both the developed infrastructure of the regions, which, in particular, was developed in anticipation of preparations for the Olympics, and the constant mentions of these territories in the media, mainly in order to show everyone that they are worth visiting.

As for the development of tourism directly in Irkutsk Oblast, we consider it important to focus on one fundamental point. The region has tremendous potential for promoting the relevant industry due to its unique comparative advantage - Lake Baikal, included in the UNESCO World Natural Heritage List. Thanks to the competent organization of the tourism industry, the economy of the entire territory could receive additional reserves for growth. However, at present, the use of the Lake does not provide an opportunity to maximize utility at the regional level and increase the level of its competitiveness. The rule "active tourism" proved in practice contributes to the enrichment of the territory, and the passive one can "impoverish" [5 p. 46] is still working in Irkutsk Oblast in the second direction.

In particular, Irkutsk Oblast took 13th place in the rating of tourist attractiveness of Russian regions in 2019. It is in the top 10 regions of Russia in terms of popularity among foreign tourists. According to the report of the Tourism Agency of Irkutsk Oblast[2], Baikal entered the top 3 most desirable vacation spots for the New 2020.

[2]Official site of the Irkutsk Oblast Tourism Agency [Electronic resource] // irkobl.ru. — Access: https://irkobl.ru/ (appeal date: 13.10.2020)

In general, over the past three years, the average increase in the volume of tourist flow to Irkutsk Oblast was more than 3.5%, and the annual increase in tourist services - 11.5%[3].

Realizing that the Lake is simultaneously part of the Olkhonsky, Slyudyankinsky, Irkutsk regions of Irkutsk Oblast and the Republic of Buryatia, in our study we focus on the first one, as the most attractive among tourists and having the largest number of growth points. It is this area, due to the relatively favorable climate, wide landscape diversity, uniqueness of flora and fauna, the presence of hydro-mineral resources, etc., that has the highest recreational potential in Oblast (2,543.2 thousand people/day) and is one of the most popular holiday destinations among locals and visitors.

The area of the Olkhonsky district is 1590 thousand hectares (15.9 thousand km2) or 2% of Oblast's territory. The administrative center is Elantsy. The Olkhonskoye district municipal entity includes: Elantsynskoye, Kuretskoye, Buguldeyskoye, Khuzhirskoye, Ongurenskoye and Shara-Togotskoye rural settlements.

The population of the territory according to data for 2019 was 9,747 people, most of whom are Buryats and Russians (tab. 2). The main sectors of the territory's economy are agriculture, retail trade and tourism.

Table 2.

The structure of the national composition of the inhabitants of the Olkhonsky district as of 01.01.2019

Nationality	Share, %	Nationality	Share, %
Buryats	48,6	Tajiks	0,13
Russians	47,2	Armenians	0,11
Ukrainians	0,43	Belarusians	0,10
Uzbeks	0,43	Evenki	010
Tatars	0,28	Germans, Kyrgyz	0,05 each

Note: compiled by the authors on the basis of summarizing sources [Official site of the Olkhonsky district municipal formation [Electronic resource] // Ольхонский-район.рф. — Access: http://xn----8sbwecbgqgbbhxj1dvg.xn--p1ai/ (appeal date: 13.10.2020)]

The main centers of attraction for tourists in the area are: Olkhon Island (Shamanka rock, Cape Khoboy and Ogoy Island with a Buddhist stupa), Tazheran steppe (a large number of various minerals, rock paintings, shaman shrines, caves and salt lakes), Maloye More (Mukhorsky, Kurkutsky, Kurminsky bays, considered one of the warmest places on Baikal, Zama is a warm lake and springs), Ogoy Islands, Oltrek, Khubyn, Edor, Kharantsy, Zamogoi, Izhilkhei.

[3]Official site of the Ministry of Economic Development of Irkutsk Oblast [Electronic resource] // irkobl.ru. — Access: https://irkobl.ru/ (appeal date: 13.10.2020)

In the Olkhonsky district, as of August 2018, 24 collective accommodation facilities operated in the village of Sakhyurta and 38 in Khuzhir [2 p. 349]; at the end of 2019, the total figure for the Olkhonsky district was 104 collective accommodation facilities located mainly on the coast Maloye More, as well as on the territory of Khuzhirskiy and Shara-Totogotskiy municipal Oblasts. In 2020, the increase in the corresponding subjects amounted to 7 units, of which five - on the mainland and two - on Olkhon Island.

Analyzing the tourist flow of the territory, in general, we can talk about positive dynamics: in 2016, 651.6 thousand people visited the region, in 2017 - at least 700 thousand people, the increase, thus, amounted to 107.4%. (fig. 2). However, it should be understood that this growth is caused exclusively by the growth of the "unorganized tourism" segment, while other niches for organizing possible tours to Baikal (ethnic, cultural, scientific, ecological, recreational, etc.) remain vacant.

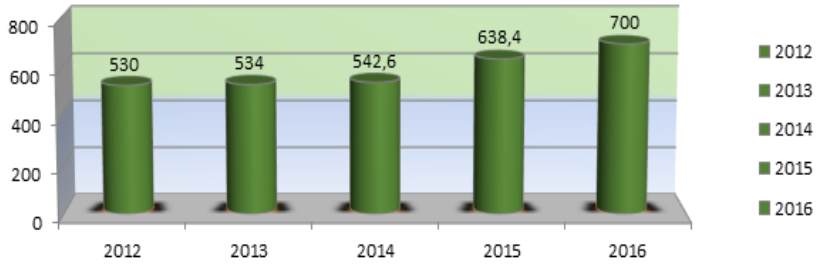


Fig. 2. *Dynamics of the tourist flow in the Olkhonsky region for 2012-1016.*

In our opinion, the main reasons hindering the intensive development of tourism on Lake Baikal, primarily in the Olkhonsky District, are: underdeveloped infrastructure, limited funding for the tourism industry from the leadership of the region and the country, the lack of combined and nature protection tours, as well as the prevalence of low cost of average check of stay at Lake Baikal (tab. 3).

In particular, due to the fact that the territory is significantly remote from the central part of Oblast, it is characterized by low development of roads. Transport communication with the regional center Elantsy is carried out on roads of IV and V technical category, which have a gravel surface, not provided with high-quality drainage and lighting means.

In order to minimize damage from the current weaknesses and leveling possible threats to the development of the tourism sector in the Olkhon region, we propose to consider the possibility of adopting and implementing the Concept for the development of the tourism industry of the relevant territory.

The concept is designed for 3 years (until 2023)

Its main goal is to develop a set of measures aimed at attracting, forming and activating tourist flows to the Olkhonsky region of Irkutsk Oblast.

The assessment of the implementation of the Concept is carried out on the basis of the growth of two main indicators: tourist flow (by 40% compared to 2016) and the volume of services provided (an increase in the average check of stay).

The target audience of the Concept is all possible groups of tourists: young people, middle-aged people, as well as the elderly. These are people who love both an active and a calm form of recreation.

Table 3.

Swot-analysis of the development of the tourism sector in the Olkhonsky district

Strengths:	**Weaknesses:**
Significant tourist and recreational potential; Availability of cultural heritage sites; Developed hotel service industry; The existing tourist flow; Location in a unique location; Availability of nat. park and reserve; Population growth, which increases the number of labor human resources	Remoteness from major administrative centers; Restriction of economic activity in the Central Ecological Zone of the Baikal Natural Territory; The need to conduct an environmental impact assessment for any object in the area 200 km from Lake Baikal; Cold climate; Lack of sufficient infrastructure for the removal (storage) or processing of waste; Lack of highly qualified personnel in the industry; Poor quality of municipal highways; Poorly developed roadside infrastructure, including petrol stations, especially in rural settlements remote from the regional center Seasonality; Low variety of assortment of tours in the area
Capabilities:	**Threats:**
The demand for tourist services on Lake Baikal; Possibility of creating new tourist routes and tours; Possibility of creating a unified information system about tourist products in the Olkhon region; Growth in demand for nature-oriented tourist programs (fishing, hunting, scientific, ethnic tourism).	A ban on economic activities in the territories located in the CEZ on the Baikal natural territory; Ban on local treatment facilities; Lack of sufficient funding from the state; The growth of anthropogenic load on the recreational areas of Olkhon, the coast of the Small Sea; Strong competition in the future from other protected areas: in Russia there are many places with beautiful landscapes, ethnic originality, UNESCO World Heritage sites; Low awareness of Russians about the tourism opportunities of the region and the district, fragmentation of information resources in the field of tourism.

Note: compiled by the authors

Implementation of the Concept involves stages.

Stage №1. Infrastructure development, which should become a "primary task" [6 p. 3]. In the transport segment, it is necessary to increase the number of paved roads, to guarantee their high-quality maintenance and safety at a level that meets technical requirements. In the information segment, it is necessary to quickly solve the problem of ensuring high-quality communication. A variant of its solution may be the conclusion of an agreement with the company "Russian Tower", which works in the relevant field. Rent of 1 cell tower per month is about 25,000 rubles, which in annual terms will reach 300,000 rubles. In the segment of infrastructure facilities, it is necessary, first of all, to work on improving the current legislative base related to the expenditure side of the budget, aimed at developing tourism in the region (in the neighboring Buryat Republic, expenses on items related to tourism and infrastructure are almost doubled more funds). Recognition of the budgetary provision for the development of the tourism sector of the entire Irkutsk Oblast, in general, and the Olkhonsk region, in particular, is insufficient at present is an objective fact [4, p. 218].

Stage 2. Resolution of the "Baikal legal anomaly", which consists in the inconsistency of the current legislation. In particular, we are talking about the fact that at present the objects that are being built on the shores of Lake Baikal should not include in their structure treatment facilities that allow to drain purified water into the ground. This is prohibited by national park legislation[4]. In order for this to become possible, it is necessary to initiate a solution to this issue “from below”. For example, to work out the option of submitting a collective petition to the administration of the region, Oblast and the country in which a list of large organizations currently working in tourism will be presented.

Stage №3. Resolving the problem of the promptness of medical care. Currently, there is no single medical center in the Olkhonsky district. Its opening will require about 7.5 million rubles. Geographically, it could be located in Elantsy, as in the largest settlement of the Region. Thanks to the implementation of this step, guests' concerns about the safety of staying on the territory, including due to the current coronavirus infection, would be significantly reduced, and new jobs would also appear.

Stage №4. Active advertising campaign for recreation on the territory of Lake Baikal. We believe that the stake should be placed on the Internet segment: create a website that will present the services of all travel organizations operating in the Olkhonsky region; launch summer and winter advertising campaigns, in which bloggers from other regions popular among young people will advise their subscribers to visit Olkhon Island. In the segment of foreign tourists, one should aim

[4]Baikal interregional nature protection prosecutor's office [Electronic resource] // baikalproc.ru. — Access: https://baikalproc.ru/ (appeal date: 13.10.2020)

at guests from Asia, since it is they who are currently in the lead in the structure of tourist traffic [1 p. 145-146, 3 p. 182]. The best option would be when tourists visiting the Lake would have the technical ability to promote recreation on Lake Baikal in their homeland. For example, foreign tourists who are already on an excursion can be given special brochures with the website address and information about other available services. Another possible option for promoting a vacation could be a referral program based on the fact that people who invite subsequent guests will receive some bonuses on the site.

We believe that in the medium term, the implementation of the proposed Concept could greatly contribute to the development of tourism on Lake Baikal.

References

1. Kazachkova O. P. Specificity of reception and service of Chinese tourists in the hospitality market of Irkutsk Oblast / O. P. Kazachkova // Intellectual and resource potential of the regions: activation and increase of efficiency of use: materials of the V All-Russian scientific-practical conference, Irkutsk, May 16, 2019 - Irkutsk, 2019. - P. 144-153.

2. Kalinina I. Yu. Priangarye - a territory of professional hospitality / I. Yu. Kalinina // Eurasian integration project: civilizational identity and global positioning: materials of the International Conference. Baikal. Forum, Irkutsk, 20-21 Sep. 2018 / under scientific. ed. E.R. Meteleva. - Irkutsk, 2018. - P. 347-356.

3. Novichkova T.R. Development of the Baikal region and the flow of tourists from China / T.R. Novichkova, O. G. Sidorenkova, M. Yan // Global and Regional Research. - 2019. - V. 1, № 1. - P. 179-183.

4. Rzhepka E. A. The current state of tourism in the Baikal region / E. A. Rzhepka, T. R. Novichkova, E. S. Aksanova // Eurasian cooperation: materials of the international. sci.-pract. conf., Irkutsk, 14-15 Sept. 2017 - Irkutsk, 2017. - P. 215-229.

5. Solodkov M.V. Export tourist potential as a factor in regulating the development of international tourism in the region / M. V. Solodkov, A. O. Borisova // Activation of the intellectual and resource potential of the regions: materials of the 4th All-Russian sci.-pract. conf., Irkutsk, May 17, 2018 : in 2 parts - Irkutsk, 2018. - Part 2. - P. 44-52.

6. Tsvigun I. V. Problems and prospects of development of ecological tourism in Russia / I. V. Tsvigun, A. Yu. Vasiliev // Bulletin of the Irkutsk State Economic Academy (Baikal State University of Economics and Law). - 2013. - № 6.

DOI 10.34660/INF.2020.18.50.002

集合的数学概念是一致性的极其抽象的概念（某些辩证矛盾的极点）

THE MATHEMATICAL CONCEPT OF A SET AS AN EXTREMELY ABSTRACTED CONCEPT OF CONSISTENCY (POLES OF A CERTAIN DIALECTICAL CONTRADICTION)

Shipovskaya Lyudmila Pavlovna
Doctor of Philosophical Sciences, Full Professor
Moscow Automobile and Road Construction State Technical University
Moscow, Russia

抽象。从概念上讲，人类的历史可以表示为科学，技术与社会之间的两个周期性联系。科学，技术和社会以这样一种方式相互联系，一个区域的变化要么是另一个区域的变化的原因或结果。熵过程（无序的特征）在其生命，生物学过程的方向上是完全相反的，它对人，更确切地说对人类基因型提出了非常严格的要求。在人类中，两个朝着相反方向牵扯的趋势正在战斗，这加剧了他两个辩证相对的方面-生物学和社会之间的关系。具有相同和不同元素的系统不是两个根本不同的系统类型，而是只有两个状态（任何系统都可以处于其中的状态），通过过渡状态的等级将极端状态连接起来。

关键词：社会需求，社会关系系统，环境变化因素，熵和负熵，系统要素，动态平衡。

Abstract. *Schematically, the history of mankind can be represented as two cyclical links between science, technology and society. science, technology and society are interconnected in such a way that a change in one of the areas is either a cause or a consequence of a change in another. The entropy process (characteristic of disorder), which is strictly opposite in its direction to life, biological processes, makes very strict requirements for a person, more precisely, for the human genotype. In man, two tendencies pulling in the opposite direction are fighting, exacerbating the relationship between his two dialectically opposite sides - biological and social. Systems with identical and different elements are not two fundamentally different types of systems, but only two states in which any system can be, extreme states connected by gradation of transition states.*

Keywords: *needs of society, system of social relations, factor of environmental change, entropy and negentropy, elements of the system, homeostasis.*

Schematically, the history of mankind can be represented as two cyclical links

between science, technology and society. One cycle begins with the emergence of a new type of scientific knowledge that generates seeds of new technologies that become the cause of social transformations. The second cycle is directed in the opposite direction: the needs of society entail technical innovations, which, in turn, stimulate the development of science. Thus, science, technology and society are interconnected in such a way that a change in one of the areas is either a cause or a consequence of a change in another.

The level of development of society is determined by the system of social relations reflecting the level of development of engineering and technology, the degree of mastery of nature, the measure of civilization, the state of culture and psychology. Therefore, society, in its essence, is a part of the material world, isolated from nature, but inextricably linked with it. Society is determined by the organized activities of human collectives who carry out actions and deeds under the influence of certain interests. At the same time, the dynamics or development of society is manifested in its historical stages (primitive, slave-owning, feudal, etc.). In order to preserve itself as an integrity, society must constantly satisfy its needs, and primarily the material needs of people, which have an objective and historically changeable character [7].

“Today we can state that human consciousness has crossed the border of the material and materialistic view of nature, formed by the dialectical method of cognition. As a result, different sensations and realizations appeared, namely: from content to context; from object to process; from perception to interaction; from display to design; from natural to artificial life; from certainty to randomness; from observable reality to constructed reality; from the behavior of forms to forms of behavior ”[2].

The system of social connections between people is complemented by a system of connections between people and the tools of production.

VI Vernadsky wrote that in the biosphere “everything is taken into account and everything is adjusted with the same precision, with the same mechanicalness and with the same submission to measure and harmony, which we see in the harmonious movements of heavenly bodies and begin to see in systems of atoms of matter and energy atoms ”[3, 24].

The fact that a person began to use tools and became a social being dramatically weakened the influence of natural selection on him. There was a "self-elimination of selection", according to Ya. Ya. Roginsky (1895—1986), which led to the attenuation and even, in the opinion of some anthropologists, to the complete stop of human evolution, ie, his phylogenetic, genotypic adaptability to the external environment. At the same time, the same factor began to drastically change the surrounding natural environment, placing the entire burden of adaptation to it on ontogenesis, on adaptability at the level of a conditioned reflex and, ultimately, on

the mental, spiritual side of a person [4, 185].

All this should be taken into account when studying the impact of technological progress on humans. As an entropic process (characteristic of disorder), strictly opposite in its direction to life, biological processes, it makes very strict requirements for a person, more precisely, for the human genotype. Moreover, these requirements are not external, extraneous for a person, but act as if from within, as part of his phenotypic, social side. In man, two tendencies pulling in the opposite direction are fighting, exacerbating the relationship between his two dialectically opposite sides - biological and social. This greatly enhances the dynamics of the inner dialectic of a person, often giving it at certain moments features of paradox, or even disunity: a person strives for one thing, but gets something opposite and vice versa, which Schiller has already seen well [6, 261].

The division of labor results in the division of society into classes, which in turn through feedback channels affect society, exacerbating the process of division of labor to such an extent that it begins, in the words of Marx, to cripple a person. And in this process, technical progress in the form that we observe today plays an important destructive role.

If in a society where between themselves and nature as an element and a system that form the integrity of a high negentropic character ("... in a society where order should increase, entropy should decrease, and negentropy should increase" E. Schrödinger), a person would place not some - that inorganic layer with completely different, purely entropic qualities, which is technology, and an equally highly organized subsystem, composed of living beings, which would not disturb, but, on the contrary, strengthened, harmonized the balance between man and nature, contributing to its merging with the latter, the division of labor would nevertheless arise in such a civilization, since the transition from the herd to society is the transition from a less holistic to a more holistic system. A growing or, more precisely, becoming "system," write A. D. Hall (1914-2009) and R. E. Feidzhin, "changes in the direction of increasing division into subsystems, sub-subsystems, or in the direction of increasing differentiation of functions" [5, 264].

This differentiation of the functions of the elements of the system is precisely inherent in the social system, in contrast to the biological system, whether it be a species or a population, where, on the contrary, each individual is extremely similar. VM Wheeler (1865-1937), one of the most important researchers of "social" insects, divided biological communities into two types: homogeneous, which he considered to be truly social, and heterogeneous, composed of various specialized individuals [3, 75].

Leaving aside the obvious incorrectness of the direct extrapolation of the features of insect communities to human society, Wheeler V.M., however, noted the problem of the difference between systems consisting of numerous identical ele-

ments and systems, which is very important for the general theory of systems and, therefore, for social science. composed of various, highly specialized elements.

Systems with identical and different elements are not two fundamentally different types of systems, but only two states in which any system can be, extreme states connected by gradation of transition states.

If the elements of a system are absolutely identical, then they form what mathematicians call a set (therefore, the mathematical concept of a set can be considered an extremely abstract concept of a system). In this case, the elements of the system have the greatest number of degrees of freedom, and the system itself becomes something ephemeral, indefinite. If the elements of the system are extremely specialized, then the system becomes very rigidly defined and indivisible. Its elements in this limiting case have only one degree of freedom, which is nothing but necessity, and as such themselves become something ephemeral. Approaching these two opposite theses dialectically, it is natural to assume that they are extreme states, or rather, poles of a certain dialectical contradiction, the most real and true form of existence of which is the state of their harmonious unity. In the language of general systems theory, it corresponds to the concept of homeostasis (homeostasis is self-regulation, the ability of an open system to maintain the constancy of its internal state through coordinated reactions aimed at maintaining dynamic equilibrium). All this is well illustrated by the example of human society. Two tendencies are clearly visible in it. One of them is the pursuit of equality for all people. It runs through the entire history of mankind, acting as one of the factors of its development. Another is the desire for organization, integrity, stability of society, which naturally requires the specialization of its members and is the second equally powerful factor in the development of society. It is easy to see that the first tendency is closely related to people as elements, and the second - with society as a system, and the state of homeostasis appears as a state of society in which the particular is in harmony with the general, the personal with the public.

References

1. *Vernadsky V. I. Biosphere. — select. op. M., 1960, V. 5.*
2. *Volobueva L.N. / Information culture as a subject of philosophical analysis // Actual problems of philosophy and political science: coll. sci. op. MADI. – M.: MADI, 2015.*
3. *Wheeler W. M. Emergent Evolution and Development of Societes. N. Y., 1928.*
4. *Roginsky Ya. Ya. Problems of anthropogenesis. - M.*
5. *Hall A.D., Feijin R.E. Definition of the concept of the system— In the book: Research on general systems theory. - M., 1969.*

6. Schiller F. Op. M., 1957, V. 6.

7. Shipovskaya L. P. Information society and its dehumanization. Collection of scientific papers based on the materials of the International interdisciplinary scientific practice, conference "Scientific and technological revolution: 4.0" Financial University under the Government of the Russian Federation. M., 2018.

DOI 10.34660/INF.2020.22.74.003

俄语交流中冲突的语言标记
LANGUAGE MARKERS OF CONFLICT IN TEXTS OF RUSSIAN COMMUNICATION

Gilazova Dilyara Rifovna
Senior Lecturer
Popova Valentina Nikolayevna
Senior Lecturer
Bashkortostan State University
Ufa, Russia

本文讨论了冲突的语言标记，这些语言标记具有很大的潜在冲突。 这些主要包括文本的可见结构：词汇语义，语法和语用手段。 这就提出了一个问题，即在分析文本的感知时必须考虑许多因素的重要性

关键词：语言单位，标记，冲突因素，感知和解释，沟通失败

Abstract*. The article discusses language markers of conflict, which carry a great potential for conflict. These primarily include the visible structures of the text: lexical-semantic, grammatical and pragmatic means. It raises the question of the importance of taking into account many factors when analysing the perception of a text.*

Keywords: *language units, markers, conflict factors, perception and interpretation, communication failure.*

Communication is a very important part of our whole life. In linguistics, in sociology and in many fields of science, conflicts, namely, communicative conflicts, are of interest for research and obtaining data in the field, caused not only by the factors of the occurrence of the conflict, but also by the variety of their types and forms. Research results can affect both intercultural and transcultural interaction. Therefore, a complete classification of the most probable conflictogenic markers identified in the analysis of texts is necessary.

One can consider the corresponding lexical-semantic, lexical, grammatical and other linguistic means as explicit markers of this phenomenon.

The purpose of our study is to use the language tools, the so-called visible text structures, to identify the most frequent and most significant in modern discourse.

Such structures clearly signal implicit goals and intentions of communicants, and therefore their analysis is of interest for research. The language elements used by the communicants carry information about the strategic and tactical intentions and attitudes of the speaker.

So, what elements, visible structures, can it be established as carrying information that serves as a "trigger" for the emergence of a speech conflict, for the so-called marker?

In our case, we consider in detail some lexical, semantic and grammatical signals of a communicative conflict.

Language, with its complex system of signs, has those that carry an ambiguous interpretation of the meanings conveyed by them. The properties of linguistic signs are embedded within them and are found only under special conditions, when certain mechanisms that bring them into action are launched. Therefore, with full right, we can consider them speech conditions: only in relation to the act of speech "virtual language sign" [Ufimtseva 1995: 247] actualizes its meaning and, therefore, can expose its conflicting conflictogenic properties.

In order to understand what properties of the language determine the occurrence of various kinds of misunderstandings and communicative failures in communication, we need to identify and describe the nature of the impact of the updated properties of the language units present in the text on the participants in the communicative act and the speech situation in general.

In this case, it is necessary to use a two-track approach, which is due to the a twofold signification of linguistic units. The unit of primary signification is the word (in the submission of the addressee), that is, the meanings of the word that represent the zone of its "nearest meaning" [Potebnya 1958: 29] and are significant for the addressee now. Moreover, the selected value zone is not necessarily the current value zone for the interlocutor. addressee What is important for the speaker is not always perceived by the listener with the same degree of understanding of the seriousness of the information as is expected from him. It is here that a situation often can provoke a conflict. A sentence or utterance is a unit of secondary signification, the word is divided into its constituent meanings, or it is precisely the meaning that is needed that is actualized. The use of units of secondary signification usually does not entail misunderstanding or contradiction between the subjects of speech (if not supported by non-linguistic factors).

This contradiction provokes the emergence of a speech conflict, and in the process of communication, new meanings appear that were not laid by the addressee, which causes misunderstanding, tension and undesirable emotional effects. All these emotional outbursts cause a speech conflict. The linguistic sign, existing in a divided and undivided form, demonstrates one of its frequently conflicting properties - flexibility. This property is manifested in its infinite semantic valence

[Losev 1982] and carries a conflict potential, as it has long been proved that any word in a particular context can turn from neutral to invective when a meaning is updated.

Consider the perception of the word by the addressee, which contributes to the emergence in consciousness of a set of verbal and subject associations, potential meanings that manifest themselves in the conditions of speech realization. Take the word "merin" (here: castrated stallion): "Two men kept about settled horses: brown old merin bought recently by Olizar...." The following notions can act as associative signs of this word: "unshakable liar" (lies as a sane merin.), "fool," hopelessly stupid man "(Stupid as a sane merin.)," lazy, "calm," predictable "[6], as well as" Merin "- it is a shot slang name for the automobile design Mercedes. It is necessary to mention some more associations: horse, car, stallion, mare. These and other associative features represent the "lexical background of a word" and adding burden to its lexical meaning in the minds of native speakers. Such features are not essential to classifying a verbal phenomenon, but they serve as a lexical background in the content of a word.

An important aspect in understanding of the language functioning are emotions and intentions of communicants. For example, usage of a neutral word to deliberately insult the interviewer in order to cause negative emotions. In this case is possible to talk about the invective use of a non-invective word. Invective always causes a violent emotional reaction. Moreover, here, because of the filling of the word with figurative components included in the "lexical background of the word," it can occur in the context of other verbal signs, reflecting collateral, implicit signs of the object to be marked [Petrenko 1983:25].

There are certain marks for lexical markers of conflict communicative behavior, they can also exist in spoken speech such little-known words as calling an unfamiliar participants of communication naming them by means of any noticable sign in appearance. Namely - the combination of the name of the noun in objective case with the preposition: wearing glasses, in a knitted jacket with those terrible roses, etc. [Zemskaya 1994:131]: "Listen, lady with earrings, you were not standing here!" Such treatment would be considered inappropriate and offensive, since any impersonation would affect the individual.

In a communicative act, the distance set by the initiator of communication plays a significant role, as well as the choice of the appropriate form of contact to the interviewer depends on the effectiveness of the communication itself, as it ultimately forms the general tone of interaction. If the speaker rejects the selected form of contact, continuing the speech contact becomes problematic.

The next lexical marker of communicative conflict may be nominative units whose meaning is unclear, unknown or alien. Words: lambada, bursac, cantonist, nakchimovitz, cadril, paj, rabfak, seminarist, styag, cadet, snob that were clear

to everyone and are little-used now and are used only by people well-read, highly educated, are well familiar with realities of the past are called «agnonimes». [Morkovkin, Morkovkina 1997]. Because of their little use, and in case these terms are present in excess quantity in the statement, they may require additional thought efforts or actions from the interviewer. Therefore, in such situations, interlocutors need to make sure that they understand each other that they use the same code (cultural competence). Here, a regulatory component of the language in the form of feedback phrases, such as, "Do you understand what I mean?" will be required to realize the informational or influencing purpose of communication. "Do you understand what I 'm talking about?" "Can I count on your understanding?" Such points should not be ignored, otherwise it may lead to a misunderstanding of the situation or statements, and may even result in conflict.

Modern online and offline communication, as well as the press, actively uses the so-called "Scum's language," a style of Russian language with phonetically adequate but purposely corrected word writing, often using obscene and certain speech stamps characteristic for slang. For example: "Afftar Write Ischo" (Author write more), "kriatiff" (creative), "Paztul" (under chair, very funny). The use of such a style can be considered as an insult usage of the Russian and cause acute aversion among the older generation, and thus can be extremely explosive.

As for grammatical structures with great potential for creating a conflict situation, these are primarily statements in the imperative inclination of the perfect aspect. These kinds of statements have a shade of rudeness, toughness and arrogance. For example, the headline of the newspaper "New Time" Quarantine Block: Let 's Wait for the Epidemic Culturally! "can be considered as a statement that the population lacks culture during normal, non-quarantine time, and this understanding can provoke negative reactions.

Our overview detection of language conflict markers is far from being complete. We have found that there are visible markers of conflict in the text at any level, but the degree of conflict of the text or speech will depend not so much on the presence of "obvious" conflict, but on the reaction of the a person perceiving and interpreting speech. Nationality, cultural background, social, religious and other components of the recipient 's personality are important. The structure of the content belongs to the text itself, while the meaning structure of the text is the meaning sphere of the person who perceives it [Novikov, 2007].

References

1. Zemskaya E.A. Category of politeness in the context of speech actions//the Logical analysis of language: language of speech actions. - M.: Science, 1994. - P. 131-136.

2. Losev A. F. Sign. Symbol. Myth. - M., 1982.- 480 p.

3. Glitkin V. V. Russian Agnonimes [Text]: (items we do not know)/V. V. Glitkin, A. V. Glitkin; Russian Int. Pushkin, Russian Int. Vinogradova, Russian Academy of Sciences. - Moscow: B. I., 1997. 414 p.

4. Novikov A.I. Text and its meaning dominants. - M.: "Azbukovnik," 2007. - 224 p.

5. Petrenko, V.F. Introduction to experimental psycho-semantics: a research of forms of representation in ordinary consciousness / V.F. Petrenko. - M.: MSU publishing house, 1983. - 176 pages.

6. Ushakov D. N. [Electronic resource]: Material from Wikipedia - the free encyclopedia: Version 10529869 - Electron. San Francisco: Wikimedia Foundation, 2008. URL: http://ru.wikipedia.org/? oldid=10529869 (date of the address: 20.03.2020)

7. Ufitseva A.A. Russians through the eyes of Russians//Language - system. Language – the text. Language – ability. M, 1995. P. 242-249.

DOI 10.34660/INF.2020.22.17.004

语言手段在冲突交流中的作用分析
THE ANALYSIS OF THE ROLE OF LINGUISTIC MEANS IN CONFLICT COMMUNICATION

Kulyeva Aigoul Albertovna
Candidate of Philosophical Sciences, Associate Professor
Bashkir State University

抽象。 本文专门介绍语言手段和分析，旨在研究对具有冲突内容的大众媒体文本的感知和理解的新趋势。 本文介绍了大众媒体文本接收者的反文本示例。 分析构成个体反义词的个体反应形式的实验数据。

关键词：大众传媒文本，冲突文本，冲突传播，知觉，引起冲突的词汇，情感成分。

Abstract. *The article is devoted to the description of linguistic means and analysis aimed at studying new trends in the perception and understanding of a mass media text with conflict content. The paper presents examples of the counter-texts of the recipients of a mass media text. The experimental data in the form of individual reactions that make up the counter-texts of the subjects are analysed.*

Keywords: *mass media text, conflict text, conflict communication, perception, conflictogenic lexis, emotional component.*

Currently, often in the process of communication, we encounter such a phenomenon as a speech conflict, in which the participants are opposing partners. Analysis of the speech conflict situation, description of the role of language tools, identification of signs of confrontation require further research and indicate the relevance of the chosen topic. The purpose of this article is to analyze language tools, vocabulary in a media text containing conflictogenic vocabulary and identify the features and properties of language tools, namely their detonating or softening qualities. The subject of the study is methods and techniques for analyzing speech acts. The object of this research is a conflictogenic media text that is part of a composite conflict discourse. A comprehensive understanding of the problem of speech conflicts is reflected in the research of foreign authors such as A. D. Grimshaw, W. A. Corsaro, D. W. Maynard.

Thanks to the efforts of modern Russian researchers B. Y. Gorodetsky, S. G. Ilenko, E. A. Zemskaya, O. P. Ermakova, I. M. Kobozeva, E. V. Paducheva, T.

V. Shmeleva, V. S. Tretyakova, we have an extensive literature that discusses and analyzes various aspects of the conflict situation. The methodological basis of the research is a comprehensive text analysis, a method of comparative analysis.

The scientific novelty of this study is that the author:

- defines the speech specificity of the conflict and identifies its characteristics;
- proves that there is a correlation between the linguistic and psychological atmosphere and the personal level of the interlocutor in the use of language tools to resolve conflict situations;

Many researchers are interested in the problem of conflict communication and it is the object of analysis not only for linguists, but also for sociologists, philosophers, and psychologists. Researchers note that conflict is a negative field of communicative influence. According to the concept of E. A. Zemskaya and O. P. Ermakova, communication failures include "an undesirable emotional effect that occurs in the process of communication that is unintended by the speaker: resentment, irritation, amazement". According to the authors, mutual misunderstanding of speech partners is expressed in failures and misunderstandings. They can be neutralized in the communication process by using additional speech steps: repeated questions, clarifications, explanations, leading questions, and reformulation [1, 45].

According to V. S. Tretyakova, a conflict implies a clash of comminicators, a state of confrontation between partners in the process of communication about conflicting interests, opinions, and communicative intentions that are revealed in a communication situation. As a result of a speech conflict, each of the partners consciously and actively acts to the detriment of the opposite partner, explicating their actions by verbal and pragmatic means [2, 147].

The analysis of the media text of the political discourse from BBC News "Russian service" from August 20, 2020 was carried out. *"Not the presidency, but a reality show."* Barack Obama lashed out at Donald Trump." "..... He described the Trump administration as *"a complete circus, baseness, deception and conspiracy theories."*

In response, the President said that he was elected because of *the "horror" that Obama left behind."*

Obama criticized Trump in his speech: *"He showed no desire to go deeper into the work. No desire to find a common language. No desire to use your enormous power to help anyone other than yourself and your friends. No desire to make the presidency anything other than another reality show in order to get the attention he craves."*

The following statements use imperatives: *"Don't let them take over the power that belongs to you. Don't let them take away your democracy,"* Obama urged voters.

At a press conference at the White House, the current President was asked what he thinks about the statements of his predecessor in his address. Trump replied: *"I see the horror that he left us, and how stupid he was doing everything. Look! What an ineffective President he was! "* It should be noted that the statements use rude, abusive language. Further, following the criticism, Trump wrote in Twitter: "Welcome, Barack and crook Hillary. See you on the battlefield!»

A small experimental study was conducted in a group of 25 students. This was a qualitative analysis of the received reactions to the media text. The analysis revealed 7 types of reactions. The following types of reactions were identified: opinion, opinion+evaluation, generalization+evaluation, conclusion+evaluation, conclusion, paraphrasing, assumption. According to the results of the experiment, mainly reactions of the complicative type were identified, that is, they contain a combination of different types of psychological reactions. This type of reaction is described in the study of I. V. Kirsanova [4, 85].

According to I. V. Kirsanova, emotions are reflected in the activity of any individual during the perception of text information. Let's look at some examples of recipients ' emotional reactions:

1) the former President of America believes that Donald Trump turned his rule into an outrageous performance, show (opinion+evaluation).

2) and Trump expressed his negative attitude to Obama, that his rule was ineffective for America (opinion+evaluation).

3) Trump is ready to fight for a place in the sun, he makes a challenge to his competitors and feels a certain threat in his speech (generalization+evaluation).

Most of the reactions includes emotional and evaluative components. Reactions containing an assessment and an opinion together account for 60% of the total number of reactions.

Examples of students 'evaluative reactions to Obama's statements about Trump's rule:

"he has an inflated self-esteem",

" he is aggressive towards Trump",

" he hates his policies",

" he has negative attitude to him",

"Trump believes that Obama's rule was unsuccessful".

According to researchers, the positive or negative attitude to information is influenced not only by the information extracted from the text, but also by the recipient's mood. Emotions play a significant role both at the stage of perception and at the stage of realization of the emotions that have arisen in the form of assessments, opinions and evaluative opinions [5, 17]. It should be noted that emotionality is given to the media text by such language tools as discourse markers, which serve as auxiliary elements for effective transmission of information to the interlocutor

[6, 155]. As a result of the experiment, we found that there is a modern tendency to pay more attention to the emotional component of the text than to the content.

In conclusion, I would like to note the following. When perceiving a conflictogenic media text, the participants of the experiment select a certain fragment of text information and react emotionally to individual words and expressions. The perception of information becomes fragmented, rather than complete. Clip thinking among young people implies a passive style of reaction to the perception of information. The experimental data obtained require additional understanding and perspective in connection with the further study of all changes in the modern information and educational environment.

References

1. Ermakova O. P., Zemskaya E. A. the construction of a typology of communicative failures (based on the natural Russian dialogue) // Russian language in its functioning and communicative-pragmatic aspect. Moscow. - 1993. - P.30-64.

2. V. S. Tretyakov. Conflict as a phenomenon of language and speech // In the scientist's lab. - Izvestiya USU.№27. - 2003. - P. 143-152.

3. https://www.bbc.com/russian/news-53846927?xtor=AL-73-%5Bpartner%5D-%5Bbbc.news.twitter%5D-%5Bheadline%5D-%5Brussian%5D-%5Bbizdev%5D-%5Bisapi%5D&at_medium=custom7&at_custom3=BBC+News+Russian&at_custom1=link&at_custom2=facebook_page&at_campaign=64&at_custom4=36365216-E2D9-11EA-928F-A1C04744363C&fbclid=IwAR2v1VxVpTsGMiAxwQlZGXrk1BvAa3h_7worw970cpargytkfljf0toe0bi-accessed August 21, 2020

4. Kirsanova I. V. "The Emotional component of the "countertext" as an element of meaning formation in the theory of text and meaning" / / Questions of psycholinguistics. - 2014. - N 22. - P. 81-93.

5. Peshkova N. P., Gilyazova D. R. Analysis of some trends in the processes of perception and understanding of mass media texts (based on the material of Internet communication). Problems of linguistics and pedagogy No. 1, 2020. - P. 8-24.

6. Kulyeva A. A. Influence of discourse markers on the perception of information / / Semantics and pragmatics of language units: history and modernity. VII international scientific conference. Collection of scientific articles. - 2018. - P. 155-160.

DOI 10.34660/INF.2020.26.99.005

“白话”在俄语语言学中的定义
DEFINITION OF «VERNACULAR» IN RUSSIAN LINGUISTICS

Potanina Olga Yurievna
Senior Lecturer
Fomina Olga Anatolievna
Candidate of Philological Sciences, Associate Professor
Don State Technical University

抽象。 这篇文章专门讨论了俄罗斯语言学中“本土”概念的定义问题。尽管“白话”一词在语言文学中长期发挥作用，但在现代作品中，它定义了截然不同的语言现象。

关键字：俄语，白话，文学语言，日常交流，社交白话，功能和文体白话。

Abstract. *The Article is devoted to the issue of defining the concept of "vernacular" in Russian linguistics. Despite the long-standing functioning of the term "vernacular" in the linguistic literature, in modern works it defines significantly different linguistic phenomena.*

Keywords: *Russian language, vernacular, literary language, everyday communication, social vernacular, functional and stylistic vernacular.*

Modern vernacular is a special functional variety of the Russian language, a specific sphere of everyday, oral-colloquial, non-literary, mostly expressive and often vulgar communication, which involves the deliberate use of profanity with certain communicative attitudes.

Russian Russian vernacular origin and formation can be traced in the works of classics of Russian linguistics, who studied the specifics of the development of the Russian literary language (A. A. Shakhmatov, S. p. Obnorsky, V. V. Vinogradov, G. O. Vinokur, etc.). the question of the folk foundations of the literary language, the formation of its various styles associated with living folk dialects, is studied in Detail. At the end of the XVI - beginning of the XVII century. spoken language gained access to writing. There are a number of new literary genres that have little connection with the old Church-book language. "Posadskaya writing of the XVII century . it was the first fixation of the Russian national language. Before the

XVIII century, the oral speech of even educated people was not yet normalized" [1]. In the XVIII century, there is a variety of cultural layers of Russian society and at the same time - a gravitation to literary forms of oral everyday communication, there is a deepening of the differences between the two types of oral speech - colloquial and "secular". The most important cultural and historical event of that era was the emergence of a system of three styles. In the 70s and 80s, the process of mixing and interpenetrating styles begins, which ends in the XIX century. democratizing the norms of the Russian literary language. It was at this time the vernacular was outside the literary norm. To 30-40 years of XIX century there were rules of a book written language, but oral literary language, spoken language as a special functional-stylistic variety of the literary language is still in the process of becoming, therefore gradually established the opposition of oral codified literary language and interpretation of tacit colloquial speech. During this period, colloquial speech is used in oral communication, which was the everyday speech of different social groups of the city, estate, and sometimes even the village. So, vernacular in the modern sense of the word arose in the middle of the XIX century and finally took shape by the beginning of the XX century. a Great contribution to the study of the problem of vernacular was also made by the works of Russian linguists L. P. Krysin, V. B. Bykov, T. V. Matveeva, V. V. Chemist, and others, as well as the German researcher Z. Kester Volumes.

The problem of colloquial speech is still poorly understood. Despite the long-standing functioning of the term "vernacular" in the linguistic literature, in modern works it defines significantly different linguistic phenomena.

In Russian linguistics, some linguists (L. V. Shcherba, A. N. Gvozdev, O. S. akhmanova, S. D. Katz, E. A. Natanson, G. F. Mitrofanov, T. S. Kogotkova, S. G. Mikhailovskaya, Yu. M.Skrebnev) claim that colloquial speech characterizes people who have not mastered the literary norm. Its features are-violation and distortion of the literary language and the presence of forms that, in their rudeness and simplicity, stand on the border of literary use.

Other linguists (Yu. s. Sorokin, E. F. Petrishcheva, V. D. Devkin, G. N. Sklyarevskaya, I. N. Shmeleva) consider vernacular as a stylistically colored layer within the literary language, characterized by simplicity and ease and opposed to high bookish, well-developed forms. Vernacular is "one of the styles of literary speech associated with direct and easy naming and defining objects, a style that sharply and emphatically reveals the essence of the subject, a style that opposes all kinds of neutral and unemotional, abstract, solemn, official and euphemistic ways of language expression" [2].

As you can see, in one case, non – literary forms are called colloquial (non-expressive from the point of view of stylistics and not geographically fixed features of speech of persons who do not know the necessary standards of the liter-

ary language), and in the other-expressive (a set of linguistic means of reduced expression).

The reason for the contradictions is the heterogeneity of the nature of this language category. Most definitions of vernacular in modern dictionaries are based on the idea of its expressive nature.

Colloquialism, understood narrowly, is a passing phenomenon. F. p. Filin made an attempt to combine two approaches to the consideration of vernacular. He emphasizes: "there are not one, but two vernaculars: 1) vernacular as a stylistic means of literary language; 2) vernacular as the speech of persons who have not mastered the literary language sufficiently" [3]. It distinguishes between literary vernacular (expressive elements) and non-literary vernacular (non-normative units). According to the researcher, non-literary vernacular "includes linguistic phenomena of all levels that an educated person can not use under any circumstances, except only on purpose, imitating the illiterate or imitating him" [3]. The expediency of such a terminological distinction is determined by the fact that both names retain the "vernacular" component, which has a long tradition of applying both to the casual speech of representatives of uneducated segments of society and to the speech of ordinary people. Thus, in modern Russian linguistics, two types of vernacular are considered.

The first is "social colloquialism" [4], i.e. speech errors of poorly educated people:

- insertion of the consonant [j]:

Штой-то ты лопаешь столько мороженого? [5].

- replacing the interrogative pronoun "what" with the colloquial "che", for example:

- Чё, глаз выпал? Иди, не белейся тут [5].

- the phenomenon of analogical leveling:

А сколько время назад? [5].

…У ней сумку прохожий отобрал… А в сумке бутылка постного масла и три кило картошки… Petrushevskaya. The little sorceress).

- declension of non-declinable nouns:

Но надо приходить с Барбями. Без Барбей не пускают. Там в газете о Барбях сказано… [5].

- use of forms of participles of the passive voice on-Ty:

Еще вчера одну женщину положили, тоже по голове стукнутая, у ней сумку прохожий отобрал… [5].

- functioning in the vernacular of reflexive verbs, which in the literary language correspond to non-reflexive:

Да, я в него плюнулась, потому что он пришел домой утром неизвестно откуда [5].

- in the forms of reflexive verbs used-Xia (in accordance with the literary-x):

Я скоро до вас доберуся! [5].

By analogy with the colloquial words, get used adverb here:

Мы уже сколько здеся сидим первые! - закричала Шура в сторону двери [5].

- "stringing" prefixes, for example:

Понаехало машин! [5].

Social vernacular is contrasted with another type of it- "functional-stylistic vernacular": non-normative units – rude, vulgar words and idioms used to Express "a special expression of reducing and simplifying speech, for a sharply negative assessment, shocking the interlocutor, for language play" [4].

This type of vernacular includes:

- serializevalue "folksy units" (Баба in the meaning of "woman," мамаша in the meaning of "mother", папаша in the sense of "father"):

Но тем временем мамаша рыбака, не подозревающая о его ночных приключениях, - эта мать увидела утром очень красивую девушку с рыжим младенцем, которые умывались у бочки на дворе, и немедленно выгнала их из дому, так как не хотела, чтобы сын женился на бабе с ребенком… [5].

- доча, сыночка (instead of daughter, son):

А кто тебе это сказал, доча? - ласково спрашивают гости [5].

Поехали, сыночка, - сказала внезапно Валентина Ивановна [5].

- reduced and / or rude nominations (including the words блин, хрен, фиг, which are euphemisms for obscene, obscene words):

А пока одни соседи воевали с огнем, другие втихаря на огородике собрали урожай с яблонь и слив … [5].

Столпились люди, кто-то сказал: «Вот так и помирают», - кто-то вызвал «скорую», и через час деда подняли и отвезли в больницу, в приемный покой [5].

- У нас сосед такой решительный! Говорит, всех порешу тут вас [5].

- Ооу, - запела певица, - нас, блин, не узнали… [5].

Установилось равновесие, летающая тарелка дрожала так, что даже Мик проснулся и с цветком мака в руке приплелся узнать, какого хрена трясет [5].

А не мыла Валька посуду (а на фиг), потому что ела с газеты … [5].

- swear words зараза, сука, паскуда, etc.:

Валька, добавим, презирала тех, кто ее не ценил, то есть все человечество и всех волшебников мира, а также всех животных, считая их полными ничтожествами: дур птиц, зараз насекомых, нахалок мышей… [5].

И выйди отсюда вон, паскуда, я тебя замочу вообще [5].

- А чтоб ты оказалась в капкане, сука, где подох твой седьмой муж … [5].

- colloquial meanings of polysemous words (for example, to bring down in the meaning of " leave»):

- Ну и вали отсюда, пока по шее не дал!.. Отвали! - сказал мужчина [5].

валить in the meaning of " come»:

Он понял, что ему привалила неслыханная удача! [5].

- typically colloquial phraseological units:

- Сейчас копыта отбросит. Пошли [5].

... Муж у ей помирает. А она как на именинах сидит [5].

- use of stable colloquial combinations (морожено-пирожено, картошка-моркошка):

Хочу морожено-пирожено! [5].

In General, language facts, which are called colloquial, belong to the periphery of the language. First of all, the term vernacular is characterized by non-normalized speech, complete lack of codification at all levels of the language. The categorical features of the vernacular are: 1) violation of literary norms; 2)more open character in comparison with other types of non-normalized vocabulary, as a result of which the vernacular is understandable to the majority of society, not limited in its use by professional and social dialects; 3) optional use, optional for members of this society; 4) bright emotional and evaluative coloration of colloquial units that Express a negative assessment of reality (rude-familiar, joking, dismissive, ironic, contemptuous); 5) the predominance of the expressive function over the nominative; 6) dynamism, manifested in the constant updating of vocabulary.

Thus, the concept of "vernacular" includes, first, a set of various grammatical, orthoepic, and other semantic deviations from the norms of the literary language, as well as reduced (coarse, vulgar, etc.) the vocabulary in speech is not enough competent people; second, individual words and the speed reduced, inscreveu vocabulary to expressive purposes are included in it literary speaking. With the General tendency to expand the stylistic space of modern literary speech, such inclusions and inclusions with various communicative and psychological motivations are observed in friendly and familiar conversation, in word games, jokes, and in mass communication.

References

1. Larin B. A. Lectures on the history of the Russian literary language (X-mid-XVII century). - Moscow, 1975. - P. 78.

2. Sorokin Yu. S. Vernacular as a term of stylistics // Reports and messages of the philological Institute. - Issue 1. - LSU, 1949. - Pp. 136-137.

3. Filin F. P. About the vernacular and colloquial in the literary language // Philological Sciences, 1979. - No. 2. - Pp. 20, 22.

4. Khimik V. V. Big dictionary of Russian colloquial expressive speech (Preface). - SPb, 2004. - P. 8.

5. Petrushevskaya L. S. Real fairy tales. - M., 2000.

DOI 10.34660/INF.2020.20.76.006

数字自闭症是新一代发展的破坏性因素
DIGITAL AUTISM AS A DESTRUCTIVE FACTOR FOR THE DEVELOPMENT OF NEW GENERATIONS

Dryaev Maxim Ruslanovich
student

Kurenevskii Aleksey Sergeevich
student
South Russian Institute of Management

Trukhanovich Darya Sergeyevna (Научный руководитель)
Senior Lecturer
South Russian Institute of Management
The Russian Presidential Academy of National Economy and Public Administration

注解。 不断发展的数字环境导致出现了新的，以前是公共关系形式的社会关系所未知的事物。 年轻一代的屏幕时间增加导致所谓数字自闭症的出现和严重发展。 现代世界中的这个问题已成为全球范围内的关键问题之一。

关键词：网络文化； 威胁；数字自闭症 检测时间；互联网；数字网络。

Annotation. *Constantly evolving digital environment has led to the emergence of new, previously unknown to the public forms of social relations. The increase in screen time of the younger generation has led to the emergence and serious development of the so-called digital autism among its representatives. This problem in the modern world has become one of the key ones at the global level.*

Keywords: *cyber culture; threats; digital autism; screen time; the Internet; digital network.*

The 21st century is marked by the arrival of digital technologies in people's lives. Every year one can observe the growing trend in the development of the Internet, digital resources and electronic devices. This follows directly from statistical studies conducted by think tanks for psychology and sociology.

The duality of the development of this mechanism of human interaction lies in the fact that, on the one hand, it is of great value for the modern world, since digital technologies in themselves are a huge breakthrough in the development of human

culture and history. On the other hand, these technologies, if used irrationally, lead to serious negative consequences, which will be discussed below.

In this context, scientists are faced with the concept of screen time, which is commonly understood to mean the time spent by a person in front of the screen of digital means, such as smartphones, tablets, computers, televisions.

It is known that back in 1997 the amount of such time was practically equal to live social communication. In 1997, the amount of screen time equaled the amount of time we spent in face-to-face communication. And by 2007, when one of the most famous consumer electronics companies Apple released its iPhone, a person's screen time was more than 8 hours, while face-to-face communication was already less than 2 hours. [3, p. 54]

Already in 2016, Justin Parent in his study proved that regardless of the stage of development of young people, a higher level of screen time of young people leads to serious sleep disorders, which, in turn, form a higher level of behavioral health problems of young people. [2, p. 11]

Many scientists are sure that in the modern world, under the pressure of such a trend, humanity is leading itself to a massive defeat by digital autism. This is a state in which young people cannot maintain long-term psychological contact with each other, they are not interested in the inner world of another person, other people have become replaceable for them, because they do not see the value of each of them individually.

The modern Russian scientist Andrey Kurpatov fully reveals the idea of mass digital autism in his works. He bases his talk on digital autism on the research of Professor Markus Reichal. According to his findings, the human brain operates in three basic modes:

1) The brain is active, which is engaged in the consumption of information. The central performance network is responsible for this.

2) The brain, which is busy with orientation in the situation. The Relevance Network is turned on.

3) The brain that thinks about nothing. The most important mode of the brain. At this moment, the brain calculates different aspects and situations. [4, p. 32]

In a normal state, a person is able to function using the potential of all three areas. Thanks to their interaction, we can get a complete picture of the world around us and rationally perceive information coming from external sources.

Later, researcher Ashley Chen supplemented the work and proved that these three systems are antagonistic to each other. With the activation of the Relevance Network and the Central Executive Network, the default thinking system is suppressed. Conversely, when networks are suppressed, the default system is activated.

That is, with the constant consumption of information, which is provided in huge quantities to active users of the digital network, the CIS is activated in them,

which in turn blocks the areas of the brain that are responsible for thinking. [1, p. 53] In this context, Kurpatov argues that the young population of many countries, including Russia, is falling into a state of mass digital autism.

The brain is unable to function efficiently and according to its normal purpose in a state of massive information influx. Humans actually block thought functions and fail to recognize many of the other psychological triggers required for goal setting and social interaction. This tendency leads to irreversible social cataclysms.

The problem of digital autism is especially prevalent today among Homelanders or Gen Z, according to Generation Theory. Here are the statistics, according to which 40% of Russian and American children consume content from the digital world most of their time. Then, according to research by scientists, the area of their brain responsible for thinking does not lend itself to development and normal functioning. This trend subsequently leads to people freezing in the digital environment and a weakening of interest in social interactions in reality. [3, p. 57]

In this context, it is extremely interesting to touch upon the phenomenon of distal vision. Evolution has shaped human thinking in such a way that he is able to form ideas about his future and set goals to achieve the desired result. If we imagine that the default system of a person turns off during the massive consumption of content from the Internet, then over time he loses the possibility of such thinking. [5, p. 123]

In the future, it is even difficult to imagine what the loss of the majority of the younger generation of the ability to set rational and achievable goals can lead to. At a minimum, in such a situation, we can face a complete destructuring of social relationships and social ties that have been built over the years.

In the modern world, people are used to choosing the simplest of two tasks, the solution of which does not require effort. It has to do with the economics of our brain. It consumes a very large amount of energy, and therefore the economic principle requires us to always choose those tasks that are easier. In the same way, content is built, which is consumed daily by the young population in huge quantities, which leads to the development of unfavorable thought processes.

Many researchers recognize the seriousness of this problem and, on the basis of their work, prove that the consequences of such cataclysms can be much more serious than it seems at first glance. They warn that the digital world is not commonplace. Moreover, they emphasize that this is an extremely dangerous mechanism of social interaction, which, in parallel with its development, develops a lot of negative consequences in society.

Thus, with the increase in the digital world, we are faced with complications that manifest themselves in the paradoxes of cyber culture. Digital autism is increasingly occurring among the younger generation, which worries many psychologists and researchers. Kurpatov, Reichal and Chen made it clear that if this trend

continues, we may soon see a completely different world with disrupted social ties and irrationally acting social mechanisms. The socialization of the individual can change radically, which will lead to irreversible social cataclysms. [6, p. 17]

To prevent such a situation, it is already urgently necessary to carefully work out a special code of digital hygiene, which would contain clear recommendations on the effective use of digital resources. Among these we highlight the following:

- Time allowed for being online;
- Conditions for combining digital and real worlds;
- Use of resources for their intended purpose;
- Restrictions on excessive use of digital resources.

This is not a complete list that must be included in such a code. However, the main goal of creating such a document is to convey to the generation the idea that the digital world is not an ordinary life that complements them. As already mentioned, often netizens erase in their imagination the boundaries between the real and the virtual world, which is extremely dangerous for their thinking and rational life.

In order to prevent the development of digital autism among the population, it is also necessary to create mechanisms for maintaining social ties, improving them and constantly improving them. With such a system, people will be able to feel more comfortable in a social environment and better implement their knowledge, skills and abilities. This is a prerequisite for keeping society out of the massive epidemic of digital autism.

References

1. Parent J, Sanders W, Forehand R. Youth Screen Time and Behavioral Health Problems: The Role of Sleep Duration and Disturbances. J Dev Behav Pediatr. 2016 May; 37 (4).

2. Suchilina A.A. Contradictions in the formation of the historical consciousness of modern Russian youth // Humanities. Financial University Bulletin. - 2020. - No. 1. - p. 95-99.

3. Sapa A.V. Generation Z - the generation of the FSES era // Innovative projects and programs in education. - 2014. - No. 2. - p. 24-30.

4. Bobrova L.A. What is thinking? // Social and Human Sciences. Domestic and foreign literature. Ser. 3, Philosophy: Abstract Journal. - 2020. - No. 3. - p. 64-77.

5. Bayburin B.U. An integrated approach to the problem of choice in the age of modern information technologies // Bulletin of Science and Education. - 2020. - No. 9-2 (87). - p. 41-43.

6. Dadahaev M.A. The phenomenon of virtual reality in the context of human existence: socio-philosophical analysis // Social and humanitarian knowledge. - 2019. - No. 9. - p. 164-170.

DOI 10.34660/INF.2020.58.11.007

关于社会主义的范畴
ABOUT CATEGORY OF SOCIALISM

Ikhlov Boris Lazarevitch
Lead Research Engineer
Special construct bureau "Lighthouse" in Perm State University

抽象。 结果表明，无论外部环境如何，社会主义国家都应该消亡。 事实证明，一个国家不可能有社会主义。 结果表明，关于资本主义和社会主义之间的过渡时期的说法是对马克思列宁主义的歪曲。

Abstract. *It is shown that regardless of the external environment, the socialist state should wither away. It is shown that socialism in a single country is impossible. It is shown that the statement about an additional transitional period between capitalism and socialism is a distortion of Marxism-Leninism.*

Introduction

The most important task of the AUCPb and CPSU was to build and strengthen socialism. But socialism can neither be built nor strengthened.

The XVI Party Conference (April 23-29, 1928) adopted the 1st five-year plan for the development of the national economy of the USSR for 1929-1932, which provided for the construction of the foundation of the socialist economy and the further ousting of the capitalist elements with the aim of their complete elimination.

The 16th AUCPb Congress (June 26-July 13, 1930) became the congress of the unfolded offensive of socialism along the entire front. In a resolution on Stalin's report, the congress instructed the CC "to ensure in the future the militant Bolshevik rates of socialist construction, to achieve the actual fulfillment of the five-year plan in four years."

By the end of 1936, the foundations of socialism, as Stalin affirmed, had been built in our country, which was enshrined in the (Stalinist) Constitution. Socialism allegedly won finally and irrevocably.

Then Khrushchev promised that communism would soon be built. Brezhnev introduced "developed socialism".

Meanwhile, Engels, speaking of the withering away of the state, notes: "The interference of the state power in social relations then becomes superfluous in one area after another and falls asleep by itself."

In his work "State and Revolution" Lenin also quotes the words of Engels about the withering away of the state: "...from this remarkably rich in thoughts, Engels's reasoning, the only real property of socialist thought in modern socialist parties is that the state" withers away ", according to Marx, in contrast from the anarchist doctrine of the "abolition" of the state..."

Socialism in a single country

Bukharin's idea of the possibility of the victory of socialism in a single country was adopted by Stalin. Usually this idea is attributed to Lenin, referring to his work "On the slogan "United States of Europe": "The unevenness of economic and political development is the unconditional law of capitalism. It follows that the victory of socialism is possible *initially* in a few or even in one, separately taken, capitalist country." The key word here is "initially", which the proponents of the idea do not notice.

The victory of the socialist revolution in a single country according to Lenin - recalls the translator of "Capital" Marx Skvortsov-Stepanov - a petty-bourgeois ideal:

"The proletariat of Russia never thought to create an isolated socialist state. A self-sufficient "socialist" state is a petty-bourgeois ideal. A certain approach to it is conceivable given economic and political predominance; in isolation from the outside world, it is looking for a way to consolidate its economic forms, which are turned into the most unstable forms by new technology and new economy".

VII Congress of AUCPb: "If you look at the world-historical scale," Lenin emphasizes, "there is no doubt that the ultimate victory of our revolution, if it remained alone ... would be hopeless."

Stalin fully agreed with this, and even after the death of Lenin, in Questions of Leninism, he could not help writing the following:

"To overthrow the rule of the bourgeoisie and establish the rule of the proletariat in one country does not yet mean ensuring the complete victory of socialism. Having consolidated its power and led the peasantry, the proletariat of the victorious country can and must build a socialist society. But does this mean that it will thereby achieve the complete, final victory of socialism, that is, does it mean that it can finally consolidate socialism with the help of only one country and fully guarantee the country from intervention, and therefore from restoration? No, it doesn't. This requires the victory of the revolution in at least several countries. Therefore, the development and support of the revolution in other countries is an essential task of the victorious revolution. Therefore, the revolution of the victorious country must consider itself not as a self-sufficient quantity, but as an aid, as a means to accelerate the victory of the proletariat in other countries."

Trotsky points out to Bukharin that a world revolution is needed in view of the availability of exports and imports of goods. However, the main point is the

backwardness, immaturity of Russia for the socialist revolution, the country. It is impossible to make a socialist revolution under a semi-feudal system, therefore Russia demands a revolution in developed countries.

Marx, in the Preface to Critique of Political Economy, writes:

"Not a single social formation will perish before all the productive forces have developed, for which it gives enough room, and new, higher production relations will never appear before the material conditions of their existence mature in the bosom of the oldest society. Therefore, mankind always sets itself only such tasks that it can solve, since upon closer examination it always turns out that the problem itself arises only when the material conditions for its solution already exist or, at least, are in the process of becoming" [1].

Stalin attributes the words "at least in *several* countries" to Lenin's position. After World War II, in fact, alleged socialist revolutions took place in a number of countries. But the meaning of the world revolution is not at all that revolutions take place in backward Bulgaria or Poland, but that they take place in developed countries, the USA, Great Britain, France, so that these countries help backward Russia. In the absence of this, the socialist revolution in Russia was doomed to failure. That in 1991 became evident already [2].

The social division of labor generates the division of society into classes. Communism is the absence of classes, not only of the bourgeoisie, but also of the working class. In the transition period from capitalism to communism, classes must wither away, and together with them the state must wither away as a tool for the suppression of one class by another. Together with the withering away of classes, the political parties representing the classes must also wither away.

In a letter to I. Weidemeyer of March 5, 1852, Marx writes: "What I did new was to prove the following: 1) that the existence of classes is connected only with certain phases of production development, 2) that the class struggle necessarily leads to the dictatorship of the proletariat, 3) that this dictatorship itself is only a transition to the destruction of all classes and to a society without classes"[3].

In his Critique of the Gotha Program, Marx writes that the task of the dictatorship of the proletariat is to destroy the old social division of labor, primarily into mental labor and physical labor (meaning rough physical labor, labor, as Marx writes, is monotonous, stupefying, depersonalizing). Everyone's work must become creative. The dictatorship of the proletariat is a process of abolishing classes, a transition to a classless society.

Marx identifies socialism and the dictatorship of the proletariat. Thus, socialism is a transitional period from capitalism to communism, during which the contradiction between mental and physical labor is resolved, thus the working class and the peasantry disappear - along with the disappearance of their labor, thus socialism is not built, not strengthened, but gradually dies off.

However, there is an obvious falsification in the literature, for example:

“At the III All-Russian Congress of Soviets of Workers ', Soldiers' and Peasants 'Deputies, Lenin recalled the experience of the Paris Commune, when the workers held out for 2 months and 10 days and were shot, paying heavy sacrifices for the first experience of a workers' government, the meaning and purpose of which the vast majority of French peasants did not know. Lenin said: "There is not a single socialist who would not recognize the obvious truth that between socialism and capitalism lies a long, more or less difficult transitional period of the dictatorship of the proletariat..." [4].

That is, it turns out that between capitalism and communism lies not one, but two whole transition periods? Perhaps Lenin made a slip?

In the Preface to v. 36 we read:

"Lenin's plan for socialist construction was based on the objective laws of the transition from capitalism to socialism, fully met the urgent needs of the country's social development, relied on a deep scientific analysis of the economy and classes of the transition period. Revealing the peculiarity of the Russian economy in the transition period, Lenin showed that "elements, particles, pieces of both capitalism and socialism" were intertwined in it, elements of five different socio-economic structures (patriarchal, small-scale commodity production, private economic capitalism, state capitalism, socialism). The economy of the transitional period combines the features and properties of socialism under construction and overthrown, but not yet destroyed, capitalism; the struggle between socialism and capitalism is the main content of the transition period, the task of which is to create "such conditions under which the bourgeoisie could neither exist nor arise again" [5].

But for Lenin everything is different, in the work "The Immediate Tasks of the Soviet Power", written in April 1918, he does not have any second "transitional period":

"The bourgeoisie has been defeated in our country, but it has not yet been uprooted, destroyed and not even completely broken. Therefore, a new, higher form of struggle against the bourgeoisie is coming to the fore, the transition from the simplest task of further expropriating the capitalists to the much more complex and difficult task of creating such conditions under which the bourgeoisie could neither exist nor arise again ... accounting and control have not yet been achieved..." [6].

In the Preface to v. 44, the compilers again write the same thing:

"V. I. Lenin taught that in the transition period from capitalism to socialism, the dictatorship of the proletariat is necessary primarily to suppress the resistance of the remnants of the exploiting classes, as well as to involve the working people in the construction of socialism" [7].

In fact, Lenin demanded to involve workers in courts, in state work, but not

in building socialism, he proposed building communism: "To build a communist society with the hands of communists is a childish, completely childish idea ... We will be able to manage the economy if the communists are able to build this economy is by someone else's hands, and they themselves will learn from this bourgeoisie and guide it along the path along which they want ... to build communism with non-communist hands" [8].

The site mentioned above links to Marx's work:

"Between capitalist and communist society lies the period of the revolutionary transformation of the former into the latter. This period also corresponds to the political transition period, and the state of this period cannot be anything other than the revolutionary dictatorship of the proletariat"[9].

The authors confused and assigned this link to page 27, while it is on page 21. But they attributed the words about the first phase to the 21st, where not a word about the first phase. There is no mention of the first phase on page 27. However, the site says in parentheses:

"The transition period from capitalism to socialism should not be confused with socialism itself, which Marx speaks of as" the first phase of communist society, in the form as it emerges from capitalist society after long agony of childbirth."

In fact, Marx writes about the first phase on another page; "But these shortcomings are inevitable in the first phase of a communist society, in the form it emerges from capitalist society after long agony of childbirth" (ibid., p. 11).

But Marx is not saying here at all that the dictatorship of the proletariat is not this first phase of communism.

The same confusion with pages, one to one, on another site with the same link (K. Marx, F. Engels Soch., v. 19, p. 27) [10]:

"Between capitalist and communist society lies the period of the revolutionary transformation of the former into the latter. This period also corresponds to the political transition period, and the state of this period cannot be anything other than the revolutionary dictatorship of the proletariat".

At the same time, the author writes an obvious absurdity:

"The need for a transition period from capitalism to socialism is conditioned; the specific nature of the emergence and formation of socialist production relations".

Wikipedia prints the same thing, with the same errors.

In a letter to Sylvia Pankhurst on 28.VIII.1919 - the same mistakes:

"... Those worker revolutionaries who make parliamentarism the center of their attacks are quite right insofar as these attacks express a fundamental denial of bourgeois parliamentarism and bourgeois democracy. Soviet power, the Soviet republic - this is what the workers' revolution has replaced bourgeois democracy, this is the form of the **transition from capitalism to socialism**, the form of the dictatorship of the proletariat".

In fact, Marx did not write about any additional transition, did not open another phase between capitalism and socialism. He simply equated the dictatorship of the proletariat with socialism:

"The class struggle in France from 1848 to 1850" (written in January - March 1850): "This socialism is the declaration of a continuous revolution, the class dictatorship of the proletariat as a necessary transitional step towards the abolition of class differences in general, to the abolition of all production relations on which they rest these differences, to the destruction of all social relations corresponding to these relations of production, to a revolution in all ideas arising from these social relations" [11].

I.e. socialism and the dictatorship of the proletariat according to Marx are one and the same.

But Lenin did not invent an additional phase either. Here is what he writes in September 1917:

"For socialism is nothing more than the next step forward from the state-capitalist monopoly. Or in other words: socialism is nothing more than a state-capitalist monopoly, turned to the benefit of the entire people and so far ceased to be a capitalist monopoly"[12]. (Let us note in parentheses that in a year Lenin will have to dissociate himself from turning monopoly towards the people when he pushes Kautsky with his "government meeting the proletariat halfway.") And further:

"The imperialist war is the eve of the socialist revolution. And this is not only because war, by its horrors, engenders a proletarian uprising - no uprising will create socialism if it has not matured economically - but because state-monopoly capitalism is the most complete m a t e r i a l preparation of socialism, there is the threshold of it, there is that historical step. a ladder between which (the step) and the step called socialism there are no intermediate steps" (ibid., p. 27, 28).

But maybe Lenin made a reservation here too, maybe after the Third Congress of Soviets he changed his mind? Not at all. On April 21, 1921, in his article "On the tax in kind," he repeats the same thing as in "The Threatening Catastrophe":

"Note that this was written under Kerensky, that we are talking here not about the dictatorship of the proletariat, not about the socialist state, but about the "revolutionary democratic" one. Is it not clear that the higher we have risen above this political step, the more fully we have embodied the socialist state and the dictatorship of the proletariat in the Soviets, the less we are allowed to fear "state capitalism"? Is it not clear that in the material, economic, production sense we are not yet on the "threshold" of socialism? And what else can you not enter the door of socialism through this "threshold" that has not yet been reached by us?

On the Trotskyist website Forum.msk, the owner of the resource, Anatoly Baranov, accuses Stalin of not understanding that building socialism - is a long term task.

"Lenin, unlike Stalin, Zinoviev, Bogdanov and Trotsky, understood that the Revolution is just a political act. The construction of socialism, however, is a hard and long-term process that can last for several generations. ... Stalin, who until 1928 had to fight his way into power, constantly waging a struggle with opponents from among the devoted Leninists - in contrast to Lenin - began to assert that Russia was already a socialist country. That is, according to Stalin, for the construction of socialism, the very political act, called the Socialist Revolution, is sufficient" [13].

That is, the Trotskyists, like the Stalinists, also believe that socialism must first be built, so that then it begins to wither away.

On the CPRF website "Socialism. Work on mistakes" (Conversation between Kiselev SA, a member of the Bureau of the Primorsky Regional Committee of the CPRF, with the editor of the newspaper Pravda Primorya), they also cite the article "Impending Catastrophe" and confirm that there are no intermediate stages between socialism and capitalism. At the same time, they still talk about building socialism.

Thus, the AUCPb - CPSU nomenclature demanded a whole historical era for itself, see [14].

I.e. by fantasizing about yet another transitional stage, the Stalinists obscured the question of the victory of the socialist revolution in a single country.

Conclusion

Engels writes: "The proletariat takes state power and transforms the means of production primarily into state property. But by doing so it destroys itself as a proletariat, thereby it destroys all class differences and class opposites..." This is a mistake, and Lenin repeats this mistake [15].

The fact is that at the moment when the working class takes power, it first eliminates only the hired *character* of labor. But the *content* of the worker's labor remains the same. The worker's labor process does not include the skills and knowledge of a manager, after a hard shift, science is not needed, if you make efforts and engage in economics or jurisprudence after work, this knowledge will fade away during the subsequent difficult shifts. Therefore, the overwhelming majority of workers will entrust both the management of the economy and control over management to a state official.

Thus, the proletarian content of labor is generated by the wage proletariat.

Lenin's idea was that the revolution in Russia would push revolutions in the developed countries so that the victorious proletariat of the developed countries would come to the aid of the Russian proletariat.

Secondly, Lenin hoped to accelerate the development of the country by, as he wrote, transferring everything advanced from developed countries. We all know he writes to the Menshevik Sukhanov that the basis determines the superstructure.

But which textbook says that you can't do the opposite? So that the revolutionary transformed superstructure grows into the base?

The world revolution did not take place. In the 30s, the "revolutionary transformed superstructure" was physically eliminated. And the basis - according to all the laws of Marxism - brought the superstructure in line with itself. Which became clear in 1991.

References

1. Marx, Engels. Op., 2nd ed. V. 2.

2. Ikhlov B. L. "Lessons of the revolution". Perm, 2011. P. 87-88)

3. Marx, Engels. Op., 2nd ed. V. 28. P. 427.

4. http://www.esperanto.mv.ru/Marksismo/Gotha/gotha.html#p11

5. Lenin. PSS, 5th ed. V. 36. Foreword. P. XIV

6. Lenin. PSS, 5th ed. V. 36. P. 175.

7. Lenin. PSS, 5th ed. V. 44. P. IX.

8. Lenin. PSS, 5th ed. V. 45. P. 98.

9. Marx, Engels. Criticism of the Gotha program. Coll. Op., ed. 2. V. 19. P. 27.)

10. http://economics.pp.ua/perekhodny-period-ot-kapitalizma-k-sotsializmu.html

11. Marx. Engels. Op.V. 7. P. 91.

12. Lenin. PSS, 5th ed. V. 34.

13. http://forum-msk.org/stalin/1250459.html

14. Ikhlov BL Why CPSU and CPRF are anti-communist bourgeois parties. P. 90-94.

15. Lenin. PSS. V. 33. P. 16.

DOI 10.34660/INF.2020.91.73.008

30年代和40年代苏联的历史唯物主义
HISTORICAL MATERIALISM IN THE USSR IN THE 30S AND 40S

Ikhlov Boris Lazarevitch
Lead Research Engineer
Special construct bureau "Lighthouse" in Perm state university

抽象。 介绍了有关第二次世界大战的事实材料。 分析了苏联经济现代化的要点。 考虑了20世纪30到40年代的一些主要理论著作。 结论是，苏联在1950年代中期所达到的水平，包括理论上的水平，都不令人满意。

关键词：新柏拉图主义，形而上学，事故，矛盾。

Abstract. *Factual material about World War II is presented. The main points of modernization of the Soviet economy are analyzed. Some of the main theoretical works of the 30s - 40s of the XX century are considered. It was concluded that the level, with which the USSR approached in the mid-1950s, including in theory, was unsatisfactory.*

Keywords: *neoplatonism, metaphysics, accident, contradiction.*

Introduction

Throughout the existence of the USSR, its chronicle was subjected to the most varied, usually opposite in nature, aberrations. Accordingly, the distortions affected both authentic Marxism and attempts at generalizing historical research. Even the term "classical Marxism" appeared, although any science presupposes denial, denial of denial, the emergence of a new one. In recent times, the speed of the formation of mythology as a reaction to liberal reality is comparable to the speed of formation of the most liberal mythology.

World War II period

Historical mythology on the "right" and on the "left" also covers the period of the 1st World War.

Let's turn to the facts. Churchill described Stalin's actions in the first days of the war very negatively: "Stalin and his commissars showed themselves at that moment of the Second World War completely muddled." The beginning of the war, the rapid retreat on almost all fronts, the tragedy of July 9 near Minsk, the Kiev boiler, two Kharkov boilers, the failure near Rzhev, the failure of the winter offensive in 1942, the inhibition of the "Katyusha" commissioning, the destruction

of the creators of the legendary MLRS, the destruction of military experts, the top of the army, the elimination of many prominent foreign intelligence officers, an attempt to replace the 45-mm guns with 107-mm guns, the removal of the gunner from the "IL" aircraft, the useless injection of funds to create double armor, etc. happened, obviously, not through the fault of the "scapegoats", the main fault lies with the top management.

Emelyanov writes: "When Pavlov was the head of the armored directorate of the General Staff, Emelyanov, as the head of the armored headquarters of the NK industrial shipbuilding, shot at the range double sheets of boiler iron, which Stalin, by mistake, recognized as protection for tanks instead of armor. Pavlov announced to Emelyanov that now they both died (for it turned out that Stalin was a fool). But they managed to cheat. It was reported that the double iron sheet is an excellent protection of tanks from bullets and shrapnel. But nothing stands still. Experience has shown that now it is necessary to protect the tank from shells. And therefore "you have to" to look for armor protection. They made it that one time" [1]

General of the Army A. V. Gorbatov: "It was believed that the enemy was advancing so quickly because of the surprise of his attack and because Germany put the industry of almost all of Europe at its service. Of course it was. But I was sweaty by my previous fears: how are we going to fight, having lost so many experienced commanders even before the war? This, undoubtedly, was at least one of the main reasons for our failures, although they did not talk about it or presented the matter as if the years 1937-1938, having cleared the army of "traitors", increased its power" [2].

Marshal of the Soviet Union A. I. Eremenko: "Comrade Stalin is significantly guilty of the extermination of military personnel before the war, which affected the combat capability of the army."

Marshal of the Soviet Union AM Vasilevsky: "Without the thirty-seventh year, perhaps there would have been no war at all in the forty-first year. In the fact that Hitler decided to start a war in 1941, an assessment of the degree of defeat of military personnel that took place in our country played an important role."

Marshal Konev, twice Hero of the Soviet Union: "There is no doubt that if the thirty-seventh-thirty-eighth years were not, and not only in the army, but also in the party, in the country, then by the forty-first year we would be incomparably stronger, what they were" [3].

The "main saboteur" of the Red Army Starinov, whom Hitler declared his personal enemy, asserts: "The repressions of 1937-38 dealt a crushing blow to the country, which affected the course of the war ... The repressions led to the fact that in the Red Army many subdivisions, units and all the more the formations and formations were commanded by, to put it mildly, unprepared people" [4].

During the discussion of the planned attack on the USSR, some of the generals

tried to convince the Fuhrer that it was premature to get involved in a war with the Russians. Hitler's answer was as follows: "80% of the commanding personnel of the Red Army have been destroyed. The Red Army is beheaded, weakened as never before, this is the main factor in my decision. We need to fight before the cadres grow up again."

According to Keitel, Hitler "constantly proceeded from the fact that ... Stalin destroyed in 1937 the entire first echelon of the highest military leaders, and there are still no capable minds among those who came to replace them."

Future Field Marshal F. von Bock: "The Russian army can be disregarded as a military force, because bloody repressions undermined its spirit, turned it into an inert machine."

The chief of the German General Staff, Halder, came to similar conclusions, who, after hearing the report of the military attaché in the USSR Krebs in May 1941, wrote in his diary: "The Russian officer corps is extremely bad. 20 years for the officer corps to reach the previous level."

Stalin's military abilities are well known, his failures during the Civil War were so great that Lenin removed him from participation in military affairs, along with Voroshilov.

Modernization of the economy

Let us consider one of the main theoretical sources of the 1940s, to the "Short Biography" of Stalin, which he himself ruled. "I. Based on Lenin's instructions, Stalin worked out the provisions on the socialist industrialization of our country. He showed that: 1) the essence of industrialization lies not in the simple growth of industry, but in the development of heavy industry and, above all, its core - mechanical engineering ... 3) socialist industrialization is fundamentally different from capitalist - the latter is built by colonial conquests and plunder, military defeats, enslaving loans and merciless exploitation of the masses of workers and colonial peoples, and socialist industrialization is based on public ownership of the means of production ... 4) therefore, the fundamental tasks in the struggle for industrialization are to increase labor productivity ... 5) the conditions for building socialism in the USSR, the labor enthusiasm of the working class - make it possible to implement the necessary high rates of industrialization ... Armed with this precise and clear program, the working people of the Soviet Union began the socialist industrialization of the country." [5, p.107-109].

However, as you know, Lenin did not give any "instructions". Lenin explained that Russia is an agrarian backward country, therefore the Bolsheviks cannot have any special socialist program, the only program is to transfer everything advanced from developed countries to Russia. Secondly, the development of heavy industry, mechanical engineering was exactly the same priority in all developed countries of the world. Thirdly, there was no public property in the USSR and could not be.

Even the slogan "factories for workers, land for peasants", which clearly denotes private property, was not implemented. The property was state owned. State property, however, is a form of private property, Engels explained in the works "Antiduring" and "The Development of Socialism from Utopia to Science." Fourth. Indeed, industrialization in the USSR differed in form from industrialization in developed countries, and this seriously slowed it down. If in the USA or Europe industrialization was carried out at the expense of workers of third countries, i.e. at the expense of strangers, then in the USSR - at the expense of the peasants. The reaction of the peasants was predictable: they responded with a reduction in crops, mass slaughter of livestock, and thousands of uprisings every year.

As for the "merciless exploitation of the masses of the workers." In the 1980s, workers in developed countries received 40% - 70% of the cost per unit of output. In the same years in Perm the workers of the plant named after Sverdlov received 12% of the unit value of the manufactured product, the workers of the plant named after Lenin - 9%, the plant named after Dzerzhinsky - 7%. Plus 3% of the factory social and cultural life.

Free medicine existed both in Great Britain and France, and in Japan there was a life-long employment institution, i.e. there was no unemployment until 2000.

Finally, about labor productivity, the rate of industrialization, and enthusiasm. There is no need to speak of enthusiasm by the mid-30s after the uprising of the Vichugian weavers, after dozens of strikes. Moreover, it is impossible to speak about the enthusiasm of the prisoners who were massively used at great construction sites.

The rate of industrialization in the USSR was indeed higher than in Western countries, especially under Khrushchev. But only because labor productivity was initially low. Even by the 1980s, it was no more than 70% of labor productivity in the United States or 60% of labor productivity in Germany and Japan.

The autobiography deals with the period of collectivization.

"II. "Stalin, comprehensively concretizing the Marxist-Leninist theory of socialism, showed that the transition to collectivization is possible not as a simple and peaceful entry of peasants into collective farms, but as a mass struggle of peasants against the kulaks. It was necessary to defeat the kulaks in open battle in front of the entire peasantry so that the masses of the peasants were convinced of the weakness of the capitalist elements, therefore the transition to complete collectivization was inextricably linked with the task of eliminating the kulaks as a class" [ibid, p.129)].

"III. Relying on Lenin's instructions about the need to move from small peasant farms to large, cooperative, collective farming in agriculture, relying on Lenin's cooperative plan, Stalin developed and practically implemented the theory of agricultural collectivization. Stalin's new in this area is that he: 1) comprehen-

sively worked out the question of the collective farm form of socialist economy in the countryside ... 3) substantiated the transition from the policy of restricting and ousting the kulaks to the policy of eliminating the kulaks as a class on the basis of complete collectivization..." [ibid, p.133-134].

However, there was no struggle of the peasants against the kulaks; the kulaks were exterminated already in the early 1920s. They deprived the middle peasants. And the struggle was fought not by the peasants, but by the authorities, the JSPD and then the NKVD. Sholokhov writes in detail to Stalin how cruelly the peasants were treated. The struggle in the form of peasant uprisings was also not against the kulaks, but accelerated collectivization according to Trotsky, as you know, after the expulsion of Trotsky, his agrarian policy was adopted, thus, Stalin did not play a role in theory at this point. Again, the uprisings were suppressed not by the peasants, but by the police, security agencies, and the army.

Historical materialism

The Biography notes:

"IV. Stalin further developed Lenin's theory of the socialist revolution. He concretized the theory of the possibility of building socialism in one country and came to the conclusion that it is possible to build communism in our country, even if the capitalist encirclement persists. This conclusion of Comrade Stalin enriches Leninism, equips the working class with a new ideological weapon, gives the party a great perspective of the struggle for the victory of communism, moves forward the Marxist-Leninist theory" [ibid., p. 170]. But this moment was not a "further development", but a complete departure from the teachings of Marx - Lenin. Lenin regarded the idea of the victory of socialism in one country as a petty-bourgeois ideal. For a detailed justification see [6].

The question of the nature of the state is inextricably linked with the question of revolution. The Biography reads:

"V. Comrade Stalin, relying on the gigantic experience of more than 20 years of existence of the Soviet socialist state in a capitalist encirclement, created an integral and complete doctrine of the socialist state. Stalin gave a detailed analysis of the stages of development of the socialist state, changes in its functions, in connection with the change in the situation, summarized the entire experience of building the Soviet state, came to the conclusion that it is necessary to preserve the state under communism if the capitalist encirclement continues to exist" [5, p. 171-172]. Meanwhile, Stalin did not create a doctrine of the state. The state, explain Marx, Engels, Lenin, is a tool in the hands of the ruling class to suppress other classes. Engels writes about another of its functions: the state "protects warring classes from mutual devouring" [7]. No one has ever argued with these moments, except that the preservation of the state was justified by the capitalist encirclement.

Of course, there is no such absurdity as the state under communism, neither in

Marx, nor in Engels, nor in Lenin, nor in Plekhanov. Practice differed even more strikingly from theory: withering away was replaced by strengthening.

Biography also covers international practice. "VII. Comrade Stalin gave examples of the scientific solution of questions of international relations and foreign policy of the USSR in the conditions of war and post-war times. Comrade Stalin developed a concrete practical program of action and policy in organizing and recreating the state, economic and cultural life of European peoples after the victory over Nazi Germany" [ibid., p. 232-233].

However, can we call examples of such solutions to international issues as avarice with the help of Spain (1936-1939), belief in a treaty with Hitler, the separation of the Comintern, the annexation of Silesia to Poland, the territory of Pomerania, vacillation between Israel and the Arabs, etc.

Theory

In "Biography" one of the main theoretical works in the USSR of the 40s is indicated:

"VI. JV Stalin's work "On Dialectical and Historical Materialism", written by an incomparable master of the Marxist dialectical method, generalizing the gigantic practical and theoretical experience of Bolshevism, raises dialectical materialism to a new, higher level, is the true pinnacle of Marxist-Leninist philosophical thought" [ibid. , p. 164-165].

The work was written in 1938, republished in 1945. "Dialectical materialism", asserts Stalin in this work, "is the worldview of the Marxist-Leninist party" [8].

From this it follows that only party members are capable of dialectical and materialistic thinking. The party has a monopoly on the correct worldview. None of the world's scientists, if they are not in the Communist Party, can have a correct worldview. How, then, do they make scientific discoveries?

Ilyenkov notes that scientists who make discoveries are dialecticians [9]. Indeed, it is impossible to make discoveries without dialectics, because a discovery is the emergence of new. But, unlike the Marxist-Leninists, they are not stable scientific dialectics, but spontaneous ones. To become scientific dialecticians, they also had to become materialists.

On the other hand, in Soviet universities it was a must to ask how bourgeois idealist scientists successfully investigate nature. It was argued that in their research bourgeois scientists are spontaneous materialists. In order to become scientific materialists, they also had to become dialecticians. But if bourgeois scientists are both spontaneous materialists and spontaneous dialecticians, therefore, they are dialectical materialists, it follows from the principles of Soviet ideology. Which, of course, is not true.

"Historical materialism", Stalin continues, "is the extension of the principles of dialectical materialism to the study of social life, the application of the principles

of dialectical materialism to the phenomena of social life, to the study of society, to the study of the history of society. In characterizing their dialectical method, Marx and Engels usually refer to Hegel as the philosopher who formulated the main features of dialectics. This, however, does not mean that the dialectic of Marx and Engels is identical with the dialectic of Hegel. In fact, Marx and Engels took from Hegel's dialectics only its "rational kernel", discarding the Hegelian idealistic husk and developing dialectics further in order to give it a modern scientific look."

Stalin does not tell how exactly Marx developed Hegel's dialectics, what exactly he added to the three laws of dialectics, how exactly he developed it. Meanwhile, there were no attempts to develop Hegel's dialectics in the USSR until the end of the 60s, by the Vyakkerevs, Batischevs, Mamardashvili and other Soviet philosophers. True, Stalin further quotes the words of Marx himself, who speaks not of dialectics, but of the dialectical method: "My dialectical method, says Marx, is fundamentally not only different from Hegel's, but is its direct opposite. For Hegel, the process of thinking, which under the name of an idea he even turns into an independent subject, is a demiurge (creator) of reality, which is only its external manifestation. For me, on the contrary, the ideal is nothing else than the material transplanted into the human head and transformed in it"[10]. Note: "transformed."

We read further: “In characterizing their materialism, Marx and Engels usually refer to Feuerbach as the philosopher who restored materialism to its rights. However, this does not mean that the materialism of Marx and Engels is identical with the materialism of Feuerbach. In fact, Marx and Engels took from Feuerbach's materialism its "main grain", developing it further into the scientific-philosophical theory of materialism and discarding its idealistic and religious-ethical layers. It is known that Feuerbach, being basically a materialist, rebelled against the name - materialism. Engels has repeatedly stated that Feuerbach "despite the materialist basis, has not yet freed himself from the old idealistic fetters", that "Feuerbach's real idealism comes out as soon as we approach his ethics and philosophy of religion" [11].

In fact, there were no "usual references", Stalin expounds the history of philosophy in an extremely simplified way, as if there were no great atomists Leucippus, Democritus, materialists Epicurus, Anaxagoras, materialistic fragments in the philosophy of Stagirite, etc. As if Marx himself did not write a dissertation on the difference between the philosophy of Democracy and the philosophy of Epicurus.

Stalin describes the very emergence of dialectics as follows: "Dialectics comes from the Greek word "dialect", which means to conduct a conversation, to conduct polemics. In ancient times, dialectics was understood as the art of achieving truth by revealing contradictions in the opponent's judgment and overcoming these contradictions. In ancient times, some philosophers believed that the disclosure of

contradictions in thinking and the collision of opposing opinions is the best way to discover the truth. This dialectical way of thinking, later extended to natural phenomena, turned into a dialectical method of cognizing nature, which considered natural phenomena as eternally moving and changing, and the development of nature as a result of the development of contradictions in nature, as a result of the interaction of opposite forces in nature."

That is: it turns out that ancient philosophers argued with each other, and then transferred their way of thinking to nature. I.e. without exploring nature, not in social and historical practice, people found and developed a dialectical approach, dialectical thinking in relation to nature, according to Stalin, emerged from the polemics of the demiurges.

Here Stalin acts as a neo-Platonist of the XX century (in contrast to the neoplatonists of late antiquity, the late Middle Ages and the early Renaissance), for Plato the dialectician is above practice, the dialectician "through only reason, strives to the essence of any object" [12].

To substantiate the supremacy of the party, it is necessary to remove the lower classes from theory, appropriate theory, the ability to generalize, and then put theory over practice.

Marx and Lenin, as materialists, argued that practice is higher than theory.

This is also why Stalin is a neo-Platonist, if we take into account the point of Plato's "program" on strengthening the role of the state, as well as dividing people into special managers of society, into those who are governed, and into guards who supervise the governed and protect the state. This fully corresponds to Stalin's understanding of the party elite as special people, standing above society, "a kind of order of the sword-bearers," as Stalin put it.

Stalin begins to expound dialectics, to put it mildly, illiterately:

"Dialectics is basically the opposite of metaphysics. The Marxist dialectical method is characterized by the following main features: a) In contrast to metaphysics, dialectics considers nature not as a random accumulation of objects, phenomena that are torn off from each other, isolated from each other and independent of each other, but as a coherent, unified whole, where objects, phenomena are organically linked to each other, depend on each other and condition each other. Therefore, the dialectical method believes that no phenomenon in nature can be understood if we take it in an isolated form, without connection with the surrounding phenomena, for any phenomenon in any area of nature can be turned into nonsense if it is considered outside of connection with the surrounding conditions, in isolation from them, and, conversely, any phenomenon can be understood and justified if it is considered in its inextricable connection with the surrounding phenomena, in its conditioning from the phenomena around it. b) In contrast to metaphysics, dialectics considers nature not as a state of rest and immobility,

stagnation and immutability, but as a state of continuous movement and change, continuous renewal and development, where something always arises and develops, something collapses and obsoletes century."

Metaphysics also does not consider nature as a state of rest and immobility. It presupposes both circulation and transformism. Metaphysics does not at all deny the regularity or interconnection of objects and phenomena.

By the way, not a single phenomenon can be understood if you do not take it in an isolated form, but try to investigate it in connection with the surrounding phenomena and conditions. How, then, did capitalist scientists, not being dialectical materialists, create quantum mechanics and the theory of relativity?

By the way, the scientific method obliges to limit the task, to pull the phenomenon out of the whole variety of connections. So, Giordano Bruno, Leibniz considered space and time dependent on material bodies, tried to consider them "organically connected with each other." Newton, in the spirit of Plato, "took space-time in an isolated form," which is why he was able, together with Hooke, to build a classical mechanics.

It should be noted that even Engels explained the emergence of metaphysics in a rather peculiar way, not from social-historical practice, but from the observations of scientists.

"It was necessary," wrote Engels, "to investigate things before one could begin to investigate processes. You must first know what a given thing is, so that you can deal with the changes that take place in it."(F. Engels, Ludwig Feuerbach and the end of classical German philosophy, 1952, p. 37).

This "method of study has left us with the habit of considering things and processes of nature in their isolation, outside their great common connection, and because of this - not in motion, but in a motionless state, not as changing in a significant way, but as eternally unchanging, not alive, but dead. Transferred by Bacon and Locke from natural science to philosophy, this way of understanding has created a specific limitation of the last centuries - a metaphysical way of thinking"[13].

Indeed, it was metaphysical thinking that created the caloric and phlogiston versions. Linnaeus argued that there are as many species as they were created by God, Newton believed that the conjunction of the Sun and the planets could not happen otherwise than by the will of God.

But one cannot deny the fact that both versions, as well as Linnaeus's classification, as well as the absolutization of space-time, served the development of chemistry, physics, and biology.

On the other hand, the dialectician Hegel in 1801 presented his doctoral dissertation "On the circulation of the planets", where he argued that it is pointless to

look for celestial bodies between Mars and Jupiter. Although a few months before the presentation, the Italian astronomer Piazzi discovered Ceres between Mars and Jupiter.

Engels himself almost rejected Newton's mechanics and believed in the existence of the ether. There are many mistakes in his book "Dialectics of Nature". This is indicative, since in his work Stalin constantly quotes Engels' statements about physics, chemistry, and biology. Stalin's work was written in 1938, the Michelson-Morley experiment, staged in 1915 and showing that the speed of light does not depend on the speed of the light source, refuted the ether version. Consequently, Stalin was poorly acquainted with the achievements of science of the XX century.

"... the dialectical method", Stalin points out, "requires that phenomena be considered not only from the point of view of their mutual connection and conditioning, but also from the point of view of their movement, their change, their development, from the point of view of their emergence and withering away. For the dialectical method, it is important, first of all, not what seems to be strong at the moment, but is already beginning to wither away, but what appears and develops, even if it looks fragile at the moment, because for it only what appears and develops is irresistible."

What, for example, can a physicist or biologist learn from such an indication? They view nature exactly as it should be investigated, and do their job without any direction.

"New social ideas and theories," asserts Stalin, "appear only after the development of the material life of society has set new tasks for society."

This is not true, the ideas of socialism emerged many centuries before October, when society faced completely different tasks. Stalin expressed himself in the spirit of crude objectivism that Marx criticized.

Or: "...in order not to be mistaken in politics, the party of the proletariat must proceed both in the construction of its program and in its practical activity, first of all, from the laws of the development of production, from the laws of the economic development of society."

But are bourgeois politicians constantly wrong? Or maliciously ignore the laws of production and economic development?

"Under the slave system," Stalin writes further, "the basis of production relations is the ownership of the slave owner to the means of production, as well as to the worker in production, the slave ... Rich and poor, exploiters and exploited, full and disenfranchised, cruel class struggle between them - this is the picture building."

"Rich and poor" and so on — this is the picture of both the feudal and capitalist systems.

There were, of course, slave revolts, and there were quite a few of them. But

it was not the slave uprisings that determined the picture of the system, and it was not their class struggle that led to the collapse of slavery. Engels noted that "...the ancient world does not know the destruction of slavery by a victorious uprising" [7].

"...capitalist relations of production, - asserts Stalin, - have ceased to correspond to the state of the productive forces of society and have become in irreconcilable contradiction with them. This means that capitalism is fraught with a revolution designed to replace the current capitalist property with the means of production by socialist property."

And so for more than 80 years, since 1938, since Stalin wrote his work, the productive forces have been in irreconcilable contradiction with the outdated capitalist production relations, and capitalism is still not fraught with revolution.

Criticizing metaphysics, Stalin himself shows himself as a metaphysician:

"If the connection between natural phenomena and their mutual conditioning represent the laws of the development of nature, then it follows from this that the connection and mutual conditioning of the phenomena of social life are also not an accidental matter, but the laws of the development of society. This means that social life, the history of society ceases to be an accumulation of "accidents", because the history of society becomes a natural development of society, and the study of the history of society turns into a science ... So, the science of the history of society, despite all the complexity of the phenomena of social life, can become the same exact science as, say, biology, capable of using the laws of development of society for practical application."

Denying randomness, Stalin does not understand that if everything in nature is natural, then everything is accidental. It is not so much about the new understanding of determinism, which was given by the theory of probability, quantum mechanics and stochastic mechanics. If Kant and Hegel endured the random as a substance, for them randomness is external to the substance, not included in the calculation, then, among other things, quantum mechanics confirmed a more correct understanding of randomness as a quality of an essential, immanent substance.

But Stalin in this fragment, speaking about patterns in history, highlighting only one side of the matter directed against the idealistic understanding of history, remains a metaphysician. Society is not arranged like a horse of Kozma Prutkov, which you click on the nose, it flaps its tail, in view of some kind of mechanical transmission from nose to tail. Marx, on the other hand, emphasized that there are no rigid laws in history, that tendencies operate in it that may not be realized. Because, for example, such a "parameter" as value, which determines the dynamics of society, is not an immanent commodity, but is contained only in the minds of people. And we see on the example of globalization that the tendency of capi-

tal to centralization, to breaking state borders, revealed by Marx, is encountering fierce resistance, nationalism is growing, countries are introducing protectionist measures, an uprising against the United States has begun and continues in Latin America.

"...the material life of society is an objective reality that exists independently of the will of people, and the spiritual life of society is a reflection of this objective reality, a reflection of being," Stalin repeats the classics. He forgets to add "transformed in consciousness", that is, remains here at the level of Aristotelian materialism, which understood the reflection of the world in consciousness like the imprint of a copper coin on hot wax. This mistake in the spirit of crude objectivism was repeated by Soviet philosophers Yudin and V.V. Orlov, who argued that there is isomorphism between objects of the external world and their reflections in consciousness, and also by the physiologist Bekhtereva, who tried to detect this isomorphism (patterns) in the electrical activity of the brain. The Soviet Marxist Ilyenkov subjected this campaign to devastating criticism.

Stalin quotes Lenin: "Development is a" struggle "of opposites" (Lenin, v. XIII. p. 301).

But he immediately writes that in the USSR "production relations are in full compliance with the state of the productive forces ... Therefore, socialist production in the USSR does not know the periodic crises of overproduction and the absurdities associated with them."

For the relations of production are so benevolent that they give full scope to the development of the productive forces, "the productive forces are developing here at an accelerated rate."

In his 1952 work, "Economic Problems of Socialism in the USSR," Stalin again asserts that there are no contradictions in Soviet society.

But if there are no contradictions in Soviet society, then, based on the above quotation from Lenin, there is no development either. Nothing can secure the movement towards communism.

After Stalin, Soviet philosophers agreed with the existence of contradictions in the USSR, but declared them not antagonistic, which, of course, is absurd.

More interesting is the following mistake of Stalin: "... c) In contrast to metaphysics, dialectic considers the process of development not as a simple process of growth, where quantitative changes do not lead to qualitative changes, but as such a development that moves from insignificant and hidden quantitative changes to open changes, to fundamental changes, to qualitative changes, where qualitative changes do not occur gradually, but quickly, suddenly, in the form of an abrupt transition from one state to another state, occur not accidentally, but naturally, occur as a result of the accumulation of imperceptible and gradual quantitative changes. Therefore, the dialectical method believes that the development process

should be understood not as a movement in a circle, not as a simple repetition of what has been passed, but as a forward movement, as a movement along an ascending line, as a transition from an old qualitative state to a new qualitative state, as development from simple to complex, from lowest to highest. "

Stalin is probably describing the boiling of a kettle on the stove.

But from what has been said in point c) it does not at all follow that development is an ascent from simple to complex, from higher to lower. Catastrophes, these qualitative changes leading to regression, also occur quickly, suddenly, in the form of an abrupt transition from one state to another, they do not occur by chance, but naturally, they occur as a result of the accumulation of imperceptible and gradual quantitative changes. That's why they are disasters. Such processes are described by the theory of catastrophes, Whitney's theory of singularities.

For Stalin, the world is developing only "upward", he does not understand that regression is an obligatory moment of development. Today we are witnessing a regression in the entire world economy, despite scientific breakthroughs, and in the psyche of people.

Conclusion

Stalin showed scientific inconsistency in the question of language [14], put forward an obviously incorrect theory of the growth of the class struggle as socialism strengthened [15]. Stalin borrowed the definition of nations from Bauer and Kautsky, respectively, it is incomplete. In his work on the national question he took a lot of fragments from Lenin without reference. Stalin's theoretical work "Economic problems of socialism in the USSR" completely contradicts Marxism, Stalin does not understand the category of contradiction, abstract and concrete labor, value [16].

"The level of development," wrote Marx, "is determined by how much science has become a productive force." In the 30-50s, over 40 thousand of the country's leading scientists were destroyed in the USSR, hundreds of thousands were placed in concentration camps and "sharashkas", genetics, microbiology, quantum mechanics were destroyed.

On such a very shaky basis, the USSR approached the mid-50s.

References

1. Emelyanov V.S. About time, about comrades, about myself. M.: Soviet Russia. 1968.

2. Gorbatov A.A. Years and wars. M.: Military Publishing, 1965. 384 P.

3. Simonov K. Conversations with Marshal of the Soviet Union I. S. Konev. M.: 1988.

4. Starinov I.G. Notes of a saboteur. M.: Almanac "Vympel", 1997.

5. Joseph Vissarionovich Stalin. Short biography. M.: Gospolitizdat. 1947.

6. Ikhlov B.L. Socialism can neither be attempted nor built. http://shtirner.ru/stati/, in the list, or here:http://www.litsovet.ru/index.php/material.read?material_id=582403

7. Engels F. The origin of the family, private property and the state.

8. Stalin I. V. On Dialectical and Historical Materialism.1938. Op., V. 14.

9. Ilyenkov E.V. Philosophy and Culture. M.: Politizdat. 1991. 464 P.

10. K. Marx. Preface to the second German edition of the 1st volume of "Capital".

11. K. Marx, F. Engels, PSS, V. XIV, P. 652-654.

12. Plato. State. Book VII. M.: Op. 1968.

13. Engels F. Anti-Dühring. M.: 1952. P. 21.

14. Ikhlov B.L. Genius of the XX century. http://www.litsovet.ru/index.php/material.read?material_id=433674)

15. Ikhlov B.L. Stalin's theory of the growing class struggle. https://www.proza.ru/2020/03/09/695

16. Ikhlov B.L. On Stalin's brochure "Economic problems of socialism in the USSR." https://www.proza.ru/2016/02/07/1447

DOI 10.34660/INF.2020.21.42.009

心态是形成政治人物形象的重要因素
MENTALITY AS IMPORTANT FACTOR IN FORMING THE POLITICIAN'S IMAGE

Karnaukhova Marina Vladimirovna
Doctor of Pedagogical Sciences, Full professor
Ulyanovsk State University
Talina Irina Vladimirovna
Doctor of Pedagogical Sciences, Full professor
Ulyanovsk State University
Karnaukhov Vladimir Anatolyevich
Candidate of Pedagogical Sciences, Associate Professor
Ulyanovsk Civil Aviation Institute
Ulyanovsk, Russia

注解。本文的目的是分析形成心态最重要的政治形象形成的理论方法。作者揭示了心态的本质意义。特别注意政治形象形成的主要机制，俄罗斯政治人物的现有分类，政治人物形象形成的因素。

作者支持这样一种观点，即政治人物与他的国家，民族和文化的认同不仅是一种心理特征，而且是一种职业特征。图像是一个复杂的多级系统，其中包括作为社会心理现象的人类图像的各个方面，同时反映了特定人固有的图像（外部-内部）原创性。

理论分析方法的应用使我们有可能得出这样的结论：这项研究有助于政治人物形象形成的发展。

关键词：政治人物形象的形成，心态，民族认同，理想形象。

Annotation. *The purpose of this article is to analyze theoretical approaches to the formation of the political image, where mentality plays the most significant role. The authors disclose the essential-meaningful characteristics of the mentality. The special attention is paid to the main mechanisms in the formation of a political image, the existing classification of politicians in Russia, the factors in the formation of a politician's image.*

The authors support the idea that the identification of a politician with his country, nation, culture is not only a psychological, but also a professional characteristic. Image is a complex multi-level system that includes various facets of the human image as a socio-psychological phenomenon and at the same time

reflects the image (external-internal) originality inherent in a particular person.

The application of the method of theoretical analysis made it possible to conclude that the study contributed to the development of the formation of the politician's image.

Key words: *formation of the image of a politician, mentality, ethno-national identification, ideal image.*

The problem of forming a politician's image in the political process worries both a beginner and an experienced politician. Nowadays politicians at all levels are concerned about their appearance in the eyes of potential voters. Experts often define political image as a purposefully formed and promoted image of a candidate, party, social or political movement, forgetting that the image exists as a phenomenon of mass consciousness in the political sphere, regardless of the implementation (and sometimes in spite of) pre-election technologies (Political imageology, 2006).

Scientists identify two main mechanisms for the formation of a political image. "Spontaneous" means the natural formation of the political image "in the heads" of voters, which occurs with the help of social - perceptual mechanisms of perception. "Artificial" means the formation of the image of a person, which is carried out indirectly, purposefully and consciously by image makers, PR specialists or by the politician himself (Budaev E.V., 2006).

Visual information seems to be very important at the initial stage. Human appearance contains the main indicators of person's characteristics: gender, age, nationality, emotional states and a number of individual psychological properties: anxiety, confidence, extraversion - introversion, etc. A generalized image of the politician is created at the stage of the first impression. Sometimes we like or don't like, we feel attraction or disaffection.

It was accepted to divide political leaders into three types in political science: traditional, legal, and charismatic. This classification depends on what their claims to power are based on.

Traditional leaders rely only on traditions. Legal leaders obtain power through legal means. Charismatic leaders do not rely on external strength, but on some unusual personal qualities, which M. Weber calls "charisma".

There are four collective images of leaders: "standard bearer", "minister", "merchant", "fireman". The leader-standard-bearer is distinguished by his own vision of reality. He has a goal, inspires people, determines the nature of events, its pace, and forms of political issues. The servant leader expresses the interests of his followers. He acts on their behalf, and the tasks of his adherents are central to him. Leader-trader bases his relationship with voters on the ability to convince voters of his strategy, to make some concessions, thereby he achieves support for

his policies. The firefighter leader reacts to the demands of the masses caused by a specific situation, which determines his actions to extinguish fires.

According to A.A. Maksimov, the following main types of politicians have formed on the political market of Russia: humanitarian, business executive, fighter, man of power, technocrat, businessman etc. (Maksimov A.A., 1999).

These types can be the basis for the election campaigns of candidates for the presidency because they are used as a pattern and the details of the politician's image are added later. Each social group has its own specific structure of the politician's image, which personifies a different type of organization and implementation of power in society. That is why it is not possible to be an ideal politician for each social group.

G.G. Pocheptsov defines the following components of the content of the politician's image: family, sports, pets, hobbies, his or her strong and weak points etc. These components can make the image of the politician more vivid and bring it closer to the "population". "These components can also support the symbolic load of the image. It should be noted that in the absence of information about "human weaknesses", they are filled by the mass consciousness arbitrarily (Pocheptsov G.G, 2006).

There are three main factors in the formation of a politician's image. The first factor is real personality traits: his or her attractiveness, age, health, clothes, gestures, temperament, character facial expressions. Presence or absence of charisma can influence the image greatly. Political positions (belonging to a particular party, movement), election program and activities of a politician are important for the image.

The second factor in the formation of a politician's image is information about this politician. The information should be correct, clear and the sources of information should be thoroughly checked. Sometimes the image of the politician can be spoiled by rumors, gossips, anecdotes, etc.

The third factor is the peculiarities of the electorate in a specific social situation of the development of society. Here, the peculiarities of the mentality, current social expectations, prevailing moods, and the state of social well-being in the society are important. An idealized idea of a candidate suitable for a certain position is significant. Bearing in mind these factors can change the attitude to the politician to the best. (Political imageology, 2006).

Mentality is a set of stable, historically formed in sufficiently long periods of time, socio-psychological and spiritual-moral characteristics that express a person's attitude to himself and others and manifested in a certain direction of consciousness, self-awareness and activity. The interest in mentality indicates that society wants to bring to the surface of consciousness those feelings and ideas that are hidden in the depths of collective memory. Nowadays we can say that the

historical part of the theory of mentality, which studies the historical determinants of people's way of life, determining their feelings, habits, traditions as the results of the world historical process is explored most of all.

According to V.O. Klyuchevsky, mentality in a historical context means “those predominantly living conditions and spiritual characteristics which are developed in the masses under the obvious influence of the surrounding nature and everything this in complex makes up what we call folk temperament, which makes it possible for representatives of national, ethnic and socio-cultural communities to perceive and realize their own natural and social environment, as well as themselves" (Klyuchevsky V. O., 2010).

From the functional side, the mentality has a special psychological mechanism for transferring ethno-national identification, which arises in the deep layers of the psyche, which transplants its “gestalt” into individual consciousness in the process of social inheritance. The interiorization of this projection is the result of a person's appropriation of a sociocultural heritage and is carried out in the process of socialization. Each civilization develops and cultivates certain personal qualities in people, and children learn these cultural values from an early age. If a person identifies himself with sociocultural traditions, he will pass them from one generation to another.

It is impossible to reveal the inner, most essential, deep mechanisms of the formation of the image of a Russian, without studying the origins, reasons, conditions that formed the Russian mentality. An important function of mentality as a unique mechanism of social heredity is to transmit the essential, socially significant features of generations by inheritance. The process of identification with a sociocultural community is especially important among politicians, and especially among political leaders. At the same time, the emphasized identification of a politician with his country, nation, culture is not only a psychological, but also a professional characteristic.

Traditionally, faith was very important in Russian culture and personality was never important in itself. Russian idealism is combined with a sublime character of reflection. It is expressed in the search for the truth and the meaning of life. It was faith in the ideal that allowed a person to break out of the ordinary, to bear the whole difficulty and hardness of reality. This belief could not be called optimistic, but it became the basis for a special feature of the historical Russian character. In this sense, the Orthodox world is based on the principles of "realism" but not "nominalism". General was always over the individual in Russian culture. A person is ready to believe in an idea and serve it. Folk proverbs and sayings reflect the archetypal traits of the Russian character: "Open the soul" (the archetype of honesty, sincerity, frankness). Radicalism is also one the most ancient archetypes of the Russian national character. Russian character can manifest a desire to take

everything to extremes. Russian people can demonstrate a rigid line of behavior and then they suddenly change their minds "with all the breadth of their souls". Another folk proverb says: “Russians harness for a long time, but they go fast”. It means that Russian people are characterized by a certain slowness from the very beginning, and then they can suddenly fulfill all plans, catch up and even overtake (Vasilenko I.A., 2011).

Some scientists think that the Russian national character was influenced by the severe natural and climatic conditions, which helped to develop the abilities for maximum exertion of all forces, the concentration of all physical and spiritual potencies. At the same time, these circumstances helped to develop traditionalism, kindness, collectivism in Russian people. A characteristic feature of the Russian mentality is its inconsistency. Some researchers consider mentality as the cultural and genetic code of every civilization.

The Russian people have patience. Love of freedom is one of the basic fundamental features of the Russian mentality. It is expressed in that organic naturalness and simplicity, in that improvisational lightness and ease, which distinguishes the Eastern Slavs from the Western peoples in general and even from some Western Slavs. This inner freedom is felt in everything: in the slow smoothness and melodiousness of Russian speech, in the Russian gait and gestures, in Russian clothes and dance, in Russian food and in Russian everyday life.

The basis of the Russian mentality is its enormous humanistic, spiritual and moral potential, which is most accurately reflected in the phenomenon of the epic Phoenix bird rising from the ashes. The fate of Russia throughout history has proven that the best in it rises in the most critical periods. The experience of humiliation of humanity, the destruction of culture, religion, morality, at the same time, tempered the Russian character, which is the key to future revival.

Globalization erases the boundaries between states, leads to unification, universalization of almost all aspects of public life, creates a single global sociocultural fusion of many national cultures. At the same time, globalization evokes a kind of "defensive reaction", awakens the instinct of self-preservation in politicians. Therefore, when communicating with the internal audience, politicians often appeal to national values, traditions, history, express patriotic sentiments, criticize other international "actors". They act under the slogan of protecting the interests of the state, ensuring the dignity or even greatness of the nation, prosperity and security of citizens. In all periods of Russian politics, the personal factors of a political leader were very significant, regardless of the qualities of specific leaders, their shortcomings or merits, and whether the leader had charisma or was a simple bureaucrat. A study lead by “Russian Academy of National Economy and Public Administration under the President of the Russian Federation” Expert and Analytical Center showed that an ideal Russian politician does not need to have

a variety of qualities; it is enough to be purposeful, have political willpower, be decent and honest. He must also be a patriot of the Motherland and pay attention to public interests first of all but not to his personal success
("Scientists have identified a portrait of the ideal politician for Russians, 2015").

Thus, image is a complex multi-level system that includes various facets of the human image as a socio-psychological phenomenon and at the same time reflects the image (external-internal) originality inherent in a particular person. The brighter the palette of image features and the more harmonious their combination, the more they correspond to the spiritual, moral, personal, professional maturity of a person, the richer, more colorful and attractive its positive image, the higher the degree of its influence on the fate of a person and his life success.

Reference

1. *Budaev E.V.Contemporary political linguistics. M, 2006.S. 24.*
2. *Klyuchevsky V. O. Course of Russian history. – AST, Astrel, 2010.*
3. *Maksimov A.A. Image of a politician. – M, 1999.S. 45.*
4. *Pocheptsov G. G.Imageology. M, 2006.S. 412.*
5. *Political Imageology / Ed. A.A. Derkach, E.B. Perelygina and others – M., – S. 203.*
6. *Scientists have identified a portrait of the ideal politician for Russians// https://iz.ru/news/591144*
7. *Vasilenko I.A. Political negotiations: Textbook. - 2nd ed., Revised, and add. – M .: INFRA-M, 2011. – 396p.*

DOI 10.34660/INF.2020.95.60.011

支气管哮喘患儿间歇性低压室低氧低氧刺激后P物质的变化
DYNAMICS OF SUBSTANCE P AFTER INTERMITTENT BAROCHAMBER HYPOBARIC HYPOXIC STIMULATION IN CHILDREN WITH BRONCHIAL ASTHMA

Alemanova Galina Dmitrievna
Doctor of Medical Sciences, Associate Professor
Popova Larisa Yuryevna
Doctor of Medical Sciences, Full Professor
Vivtanenko Tatiana Vladimirovna
Candidate of Medical Sciences, Associate Professor
Volyanik Olga Vladimirovna
Candidate of Medical Sciences, Associate Professor
Orenburg State Medical University

抽象。 确定了间歇性压力室缺氧对缓解期间40例严重程度不同的支气管哮喘（BA）患儿血清P物质水平的影响。 间歇压力室缺氧的过程是在多位置低压室“ Ural-1”的条件下进行的。 轻度BA更常观察到良好的临床效果。间歇性压力室缺氧3个月后，BA患儿神经肽产生的阳性动态表现为血清中P物质浓度的降低，而与疾病的严重程度无关。

关键词：支气管哮喘；儿童； P物质；间歇性压力室缺氧

Abstract. *The effect of intermittent pressure chamber hypoxia on the level of substance P in the blood serum of 40 children with bronchial asthma (BA) of varying severity during remission was determined. The course of intermittent pressure chamber hypoxia was carried out under conditions of a multi-place hypobaric pressure chamber "Ural-1". Good clinical effect was more often observed with mild BA. The positive dynamics of neuropeptide production in children with BA 3 months after the course of intermittent pressure chamber hypoxia was manifested by a decrease in the concentration of substance P in the blood serum, regardless of the severity of the disease.*

Keywords: *bronchial asthma, children, substance P, intermittent pressure chamber hypoxia*

Introduction

The modern definition of bronchial asthma (BA) is interpreted as a disease based on chronic inflammation of the airways and associated bronchial hyperreactivity [1]. The prevalence of various phenotypes of asthma with the features of the mechanisms of pathogenesis is noted [2]. Airway hyperreactivity is a physiological disorder due to the heterogeneity of the mechanisms in bronchial asthma. At present, inflammatory neuroimmune processes mediated and regulated by cytokines and neuropeptides are of great importance in the pathogenesis of bronchial hyperreactivity in BA [3]. At the present stage, it has been proven that neurogenic mechanisms with the participation of neuropeptides are of great importance in the formation of the inflammatory process in the bronchi. Peptide hormones are called "neuropeptides" due to their ability to influence the central nervous system. The effects of neurogenic inflammation, manifested in the course of the disease, undoubtedly affect its severity and course. Neurogenic inflammation involving neuropeptides can accompany and aggravate existing allergic inflammation. Substance P - is a neurotransmitter of non-cholinergic excitation, one of the main mediators of neurogenic inflammation, involved in the development of edema, mucus hypersecretion, and bronchospasm. Mediators secreted by nerve cells (substance P, vasoactive peptide, etc.), acting on specific receptors, contribute to the degranulation of mast cells with the release of a complex of biologically active substances (histamine, tryptase, nerve growth factor, etc.), which activate the inflammatory process. The accumulation of substance P is capable of initiating many of the pathophysiological reactions characteristic of BA (spasm of bronchial smooth muscles, edema of the bronchial mucosa, hypersecretion of mucus), and can deepen the chronic inflammatory process in the bronchi [4,5]. The development of optimal complexes of drug and non-drug therapy in different phases of the disease, taking into account the individual characteristics of the course of BA, seems to be a promising direction in terms of personalized therapy. One of the non-drug methods of treating BA in children is intermittent pressure chamber hypobaric hypoxic stimulation (PCHHS). When adapting to hypoxia, not only the power of the sympathoadrenal system increases, but the body's resistance to other damaging factors also increases [6].

Purpose

Based on the available data on the effect of neurogenic inflammation on the severity and nature of BA, to assess the participation of substance P in the pathogenesis of BA in children and the effect of PCHHS on the dynamics of this indicator depending on the severity of the disease.

Materials and methods

We examined 40 children aged 6-16 years suffering from atopic BA of varying severity in the period of remission (12 children with mild persistent and 28

patients with persistent moderate severity) who received a course of PCHHS. The control group consisted of 30 apparently healthy children of the same age. BA was diagnosed on the basis of anamnesis, general clinical and allergic examination. The average duration of the disease was 4.1 ± 0.4 years. BA heterogeneity is determined by a variety of biological defects. Abnormal pregnancy was revealed in 50% of mothers (n-20) of the examined children. The majority of mothers 45% (n-18) during pregnancy ate foods that are obligate allergens of group 1. Pathology of the neonatal period was observed in 30% of newborns (n-12). Artificial feeding was received by 55% of children (n-22). Complicated heredity was detected in 90% of children (n-36), and in 50% of children (n-18) both parents suffered from allergic diseases. Acute respiratory viral infections (ARVI) - in 55% of children (n-22), a history of community-acquired pneumonia - in 12.5% of children (n-5) were often the immediate cause of the first broncho-obstructive syndrome. ENT organ pathology was diagnosed in 35% of children (n-14). The structure of significant allergens was different depending on age: at the age of 6-9 years, food and household allergens were significant. In children aged 10 - 16 years, polyvalent sensitization was noted: household, sensitization to plant pollen, epidermal, (the frequency of food sensitization significantly decreased).

The PCHHS course in a multi-place hypobaric pressure chamber "Ural-1" was carried out according to the standard method. The duration of treatment was 24 sessions lasting 1 hour [7]. Adaptation to pressure chamber hypoxia was carried out by gradually lifting children at a speed of 2-3 m/second, starting from a "height" of 500 meters to a final "height" of 3500 meters. The descent was carried out at a speed of 1-3 m/second. Before the PCHHS course, all patients were in remission, which was due to basic therapy (cromones, low doses of ICS). The severity of BA was assessed by its clinical manifestations in the period of exacerbation preceding hypoxic barotherapy. To assess the clinical efficacy of PCHHS, 4 main indicators were chosen: frequency, severity, duration of attacks of bronchial obstruction, and the effectiveness of bronchodilator therapy. The listed signs are ranked during BA exacerbation according to their severity on a five-point scale. BA severity was assessed by the sum of points: mild severity - 8 points, moderate severity - 12 points, severe BA severity - 13 or more points. The main clinical signs of BA severity and the duration of remission were compared to assess the effectiveness of treatment in the year preceding and following the PCHHS course. The effect was assessed as good with a decrease in the severity of clinical manifestations of the disease after a year by 4 points or more, as satisfactory - by 3 points, as no effect - if the number of points decreased by 1-2 or did not change. The content of substance P in serum was determined before and 3 months after PCHHS by ELISA using standard kits. The data obtained were processed by statistical methods using the Biostatistics software. The research results are presented in the form of the arithmetic mean,

the mean error of the arithmetic mean, the limits of fluctuations (max and min). The significance of differences in the compared groups was identified using the Student's t-test. Differences were considered significant at $p < 0.05$.

Results and discussion

Studies have shown that a positive result of treatment one year after PCHHS with mild severity was noted in 92.8% of cases, with a good effect in 78.5% of patients, satisfactory - 14.3%; 7.2% of children had no clinical effect. With moderate BA, a positive result of treatment after hypoxybarotherapy was achieved only in 77.3% of patients, of which a good effect was observed less often - in 50.7%, satisfactory more often - in 26.6%; no clinical effect was observed in 22.7% of patients. The PCHHS course has a positive impact on the course of BA. It should be emphasized that a positive result of treatment was obtained regardless of the severity of the disease, however, a good clinical effect was more often observed with mild BA. The manifestations of the clinical effect of PCHHS are associated with the influence on various links of pathogenesis.

The results obtained during the study showed that the level of neuropeptides was determined by the period and severity of the disease. The average concentration of the substance during the period of remission was significantly higher than the normal value (2.5 ± 0.91 pg/ml), and with moderate BA it was significantly higher than in patients with mild disease severity ($p < 0.05$; table 1).

Table 1.

Dynamics of the level of substance P (pg/ml) in the blood serum of children with atopic BA of varying severity during remission (M + m)

Severity of BA	Norm (n-10)	Before PCHHS (n-40)	3 months after PCHHS (n-40)
Light persistent (n-12)	2,5±0,91	20,44±2,34*	9,41±1,12***
Moderate persistent (n-28)	2,5±0,91	46,18±8,11*	20,36±4,41***

Note: * - reliability of differences compared to the norm;

** - significance of differences before and 3 months after PCHHS ($p < 0.05$)

Under the influence of the PCHHS course, there was a significant change (improvement) in the substance P index, regardless of the severity of BA. The level of substance P in patients with mild and moderate BA decreased and became significantly less than the initial level 3 months after the end of hypoxic barotherapy (table 1). An increase in CP activity during BA remission in the examined patients indicates the presence of both an allergic and a neurogenic component of inflammation in the airways, regardless of the BA severity. PCHHS in our patients leads to unidirectional changes in neurohumoral regulation, which are manifested by a decrease in the level of CP, one of the mechanisms of neurogenic inflammation.

A significant role in the mechanism of the therapeutic action of PCHHS under conditions of a hypobaric pressure chamber belongs to hypoxemia, which develops as a result of a decrease in the partial pressure of oxygen in the inhaled air of the pressure chamber, followed by tissue reoxygenation that occurs after the patient returns to the "normal atmosphere". In the process of individual adaptation to intermittent hypobaric hypoxic stimulation, memory reserves are created on the basis of the formation in the body through the synthesis of nucleic acids of a bank of memorable structural traces that form the basis of long-term sustainable adaptation. Thanks to the branched architectonics of the structural trace, not only a direct, but also a cross-protective effect of adaptation is manifested. The initial period of adaptation to hypoxia is accompanied by excitation of the sympathetic part of the nervous system and leads to an increase in the concentration of catecholamines in the blood, an increase in glucocorticoid function of the adrenal glands due to the physiologically active free fraction of the hormone, which contributes to bronchodilation and enhancement of the function of the bronchial glands [8]. The data obtained indicate that the mechanism of the therapeutic effect of PCHHS is realized through modulation of the mechanisms of neuroendocrine regulation, which is manifested by a weakening of the expansion of CP. The body's response to oxygen deficiency is a consequence of a complex multifunctional response of the cell, coordinated by neurohumoral mechanisms.

Conclusion

Thus, this study revealed that the PCHHS course has a positive effect on the course of BA, regardless of the severity, with the achievement in most cases of a good clinical effect with mild disease severity. PCHHS in our patients leads to unidirectional changes in neurohumoral regulation, which are manifested by a decrease in the level of CP, one of the mechanisms of neurogenic inflammation.

Revealing the corrective effect of PCHHS on the mechanisms of neurogenic inflammation expands the possibilities of this method of treatment.

References

1. National program Bronchial asthma in children. Treatment strategy and prevention:.- 5th ed., rev. and add. - Moscow: Original-model, 2017. – 160 P.

2. Nenasheva N.M. New treatment options for severe bronchial asthma: from clinical studies to patient portraits / Russian Allergological Journal. - №3. - 2015. P. 51-60

3. Sultanova N.G. Analysis of the intersystem interaction of a number of neuroimmune parameters in atopic bronchial asthma in children/ Pulmonology. - №3. - 2010. - P.62-66.

4. Lev N.S. Neuropeptides and other neurohumoral regulators in the pathogenesis of bronchial asthma in children/ Russian Bulletin of Perinatology and Pediatrics.- 2000. - №2. P.19-23.

5. Eyyubova A.A., Allakhverdieva L.I., Sultanova N.G. The role of neuropeptides in the pathogenesis of bronchial asthma in children/ Immunology.- 2008.-V.29, №5. P.290-292.

6. F.Z. Adaptation medicine: mechanisms and protective effects of adaptation/ F.Z. Meerson. - M.: HypoxiaMedical LTD, 1993. - 331 P.

7. A method for increasing the effectiveness of treatment of bronchial asthma in children and adolescents using hypobaric hypoxic stimulation: New medical technology of FC № 2010/045/ G. D. Alemanova [et al.]. - Orenburg, 2010. - 30 P.

8. Meerson, F.Z. The two-phase nature of the phenomenon of adaptive stabilization of structures in the process of long-term adaptation to stress / F.Z. Meerson, I. Yu. Malyshev, A.V. Zamotrinsky // Bulletin of Experimental Biology and Medicine.-1993.- №10.- P.352 - 354.

DOI 10.34660/INF.2020.60.98.012

使用最佳咬合面构建方法对正畸治疗结果进行定量评估

QUANTITATIVE EVALUATION OF THE RESULTS OF ORTHODONTIC TREATMENT USING THE METHOD OF CONSTRUCTING THE OPTIMAL OCCLUSAL PLANE

Fadeev Roman Aleksandrovich
Doctor of Medical Sciences, Full Professor
Head of Department
Mechnikov North-West State Medical University
Head of Department
St. Petersburg Institute of Postgraduate Dentistry
Full Professor
Yaroslav-the-Wise Novgorod State University
Lanina Anastasiia Nikolaevna
Candidate of Medical Sciences, Associate Professor
St. Petersburg Institute of Postgraduate Dentistry
Timchenko Vladimir Vladimirovich
Candidate of Medical Sciences, Associate Professor
St. Petersburg Institute of Postgraduate Dentistry
St. Petersburg, Russia

抽象。 作者R.A.在文章“使用构建最佳咬合平面的方法对正畸治疗结果进行定量评估”中。 法德瓦（A.N.） 拉尼娜（V.V.） Timchenko介绍了在“Allegro”程序中构建最佳咬合面的方法的实际应用，以及定量评估正畸治疗AMORF结果的方法。

关键词：构建最佳咬合面的方法，牙颌面畸形的定量评估，疾病的严重程度，美学，形态，咬合，功能，吸收，牙齿闭合位置，保留，牙本质，功能性疾病，“快板”，AMORF。

Abstract. *In the article "Quantitative assessment of the results of orthodontic treatment using the method of constructing an optimal occlusal plane" by the authors R.A. Fadeeva, A.N. Lanina, V.V. Timchenko presents the practical application of the method for constructing the optimal occlusal plane in the "Allegro" program, as well as the method for quantitative assessment of the results of orthodontic treatment AMORF.*

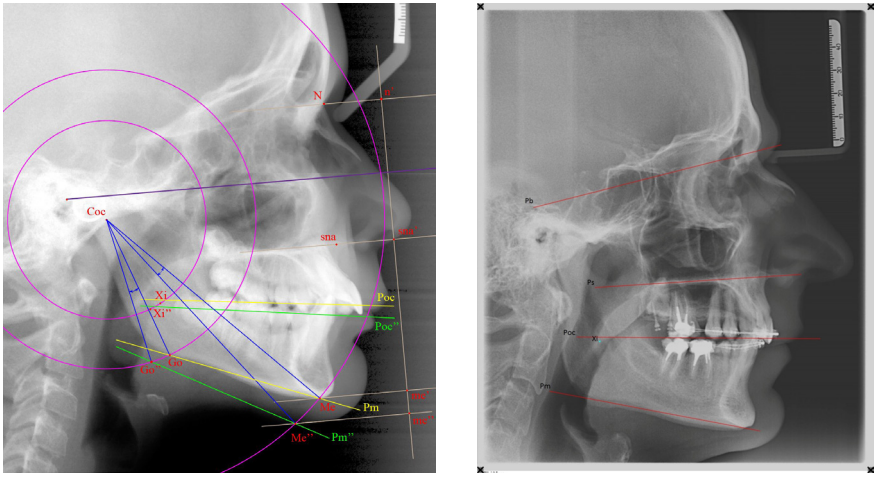
Keywords: *method of constructing an optimal occlusal plane, quantitative*

assessment of dento-maxillofacial anomalies, severity of disorders, aesthetics, morphology, occlusion, function, resorption, close position of teeth, retention, adentia, functional disorders, "Allegro", AMORF.

Introduction. Dentoalveolar-facial anomalies (DFA) are characterized by a number of features, including morphological, aesthetic, occlusive, resorption of periodontal bone tissue, as well as functional disorders, close position of teeth, their retention, root resorption and adentia. The tactics of correcting DAFA depend on the severity of these signs, and its effectiveness depends on the dynamics of their severity at the end of treatment. [6, 7]. In order to quantify DAFA signs, we proposed and tested on more than 1000 patients with DAFA the AMORF quantitative assessment method ("A" - Aesthetics, "M" - Morphology, "O" - Occlusion, "R" - Resorption, "F" - Function), which allows to identify 3 degrees of severity of aesthetic, morphological, occlusive disorders, as well as to assess the resorption of periodontal bone tissue in the sagittal, vertical, transversal directions, 3 degrees of functional disorders, close position of teeth, their retention, root resorption, 2 degrees of adentia [1, 8]. At the same time, a comparison of the quality of the treatment performed in patients with DAFA showed that in the group of patients who underwent treatment taking into account the search and construction of the optimal occlusal plane, the improvement of morphological and aesthetic signs of DAFA was more pronounced than in patients without it [3, 4, 5].

Practical application. To build an optimal occlusal plane, the first step is to determine the proper height of the face and the position of the patient's lower jaw. In Figure 1a: n'-me '(Pn) is the front face height, n'-sna' '(Pn) is the front upper face height, sna'-me' (Pn) is the front lower face height. The length ratio of n'-sna '(Pn) to sna'-me' (Pn) is normally 0.816 [2]. Thus, knowing the value of the front upper height of the face, we can determine what the front height of the face should be by dividing the value of the n'-sna '(Pn) length by 0.816. In order to determine the new position of the lower jaw and build the plane of the base of the lower jaw, it is necessary to find a new location of the points Me and Go: Me ”and Go”, respectively. In Figure 1 a, the “me” point is the projection of the “Me” point at the optimum front face height. Point Me ”is at the intersection of the perpendicular to the plane Pn, drawn through point me”, and a circle of radius Coc-Me centered at point Coc. To determine the position of the Go point, the Go-Coc-Go angle is constructed, equal to the Me-Coc-Me angle, and a circle of radius Coc-Go centered at the Coc point. The desired point Go is located at the intersection of this circle and the Coc-Go ray ”. Thus, the required position of the plane of the base of the lower jaw Me ”- Go” is determined. The optimal occlusal plane divides the intermaxillary angle in a ratio of 27:73. To determine the vertical level of passage of the occlusal plane, it is necessary to focus on the point Xi, which is the geometric center of the lower

jaw branch (Ricketts), which should be located 0.72±0.7 mm below the occlusal plane (fig. 1 b). These calculations can be done using the computer program developed by us "Allegro" (certificate of state registration of the computer program № 2017660108 "Calculation of lateral teleroentgenograms with determination of the proper face height and optimal occlusal plane - Allegro").



a *b*

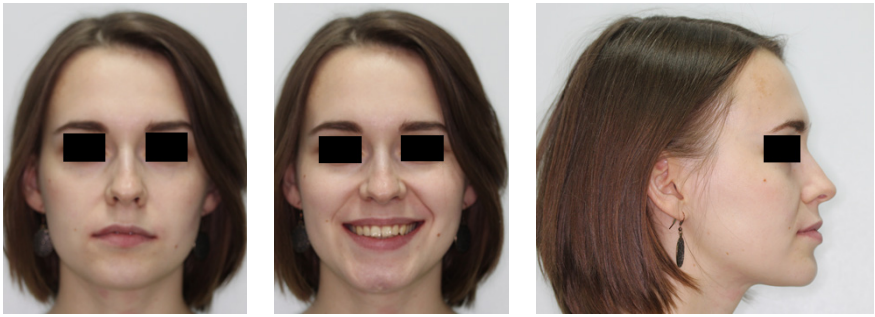
Figure 1. *Lateral TRG of the patient and the search for the optimal occlusal plane (a); location of the occlusal plane relative to Xi (b)*

The method of quantitative assessment of AMORF is that the degree of severity of each DAFA sign is determined by the doctor and enters the numerical values into the corresponding table (table 1). Next, the total numerical indicators for the blocks before and after treatment are determined and its result is interpreted in one of the following formulations: up to 25% - "significant improvement"; 25-45% - "significantly improved"; 45-65% - "moderately improved"; 65-85% - "minimally improved"; 85% or more – "not improved or worsened".

To demonstrate the application of the method for constructing the optimal occlusal plane in the "Allegro" program, as well as the method for quantifying the results of orthodontic treatment AMORF, we present an extract from the medical history.

Patient P., 29 years old (Fig. 2-c, 3 a-e), She went to the clinic with complaints of intense closing of the lips, fatigue of the muscles of the maxillofacial region, uneven position of the lower teeth. The *diagnosis*: *neutral ratio of the jaws, protrusion of the upper incisors, tight position of the teeth, parafunction of*

the masticatory muscles. From table 1 it can be seen that the main disorders were in the function and corresponded to the 2nd degree of severity. There were also violations of the aesthetics of the face in the sagittal and transversal directions, morphology - in the sagittal, corresponding to grade 1. Electromyography (EMG) performed on the Zebris Medical GmbH device showed fatigue of the left temporal and masseter muscles (fig. 4 a).



a *b* *c*

Figure 2. *Photos of the patient T.'s face upon admission to the clinic (a-c)*

a *b* *c* *d* *e*

Figure 3. *The ratio of the dentition of patient P. before treatment (a-e): the close position of the teeth of the 1st degree is determined (d, e)*

Table 1

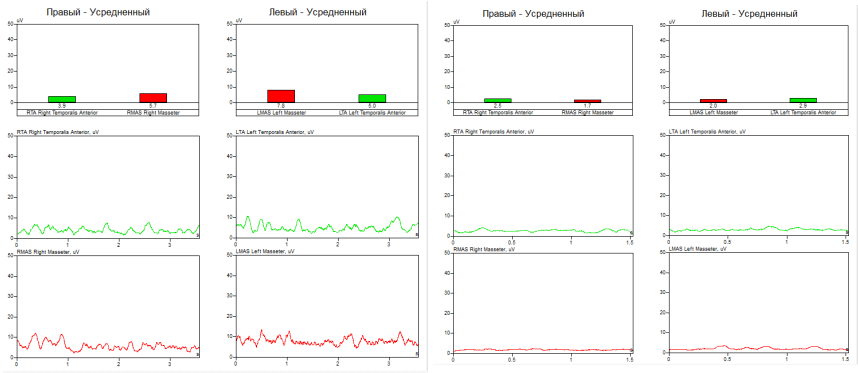
Quantification of DAFA signs of patient P., 29 years old, before/after AMORF treatment

Direction	A	M	O	R	F
Sagittal	1/0	1/0	0/0	0/0	2/0
Vertical	0/0	0/0	0/0	0/0	
Transversal	1/1	0/0	0/0	0/0	

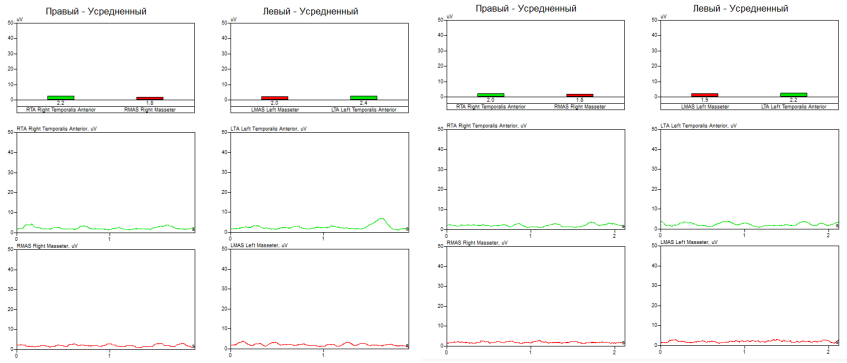
Sign	*1 degree*	*2 degree*	*3 degree*
Tight position	+/0	-----	-----
Retention	-----	-----	-----
Root resorption	0/0	-----	-----
Adentia / excess space	-----	-----	

As a result of the diagnostic studies and recommendations on the choice of treatment tactics, the following *plan* was proposed for DAFA correction: *1. Construction of the optimal occlusal plane in the "Allegro" program; 2. Relaxation of the masseter and temporal muscles by means of transcutaneous electrical nerve stimulation (TENS) on the "Scenar" apparatus, repeated electromyography, obtaining a register of the ratio of the jaws; 3. Muscle relaxation tray for the lower jaw 4-6 months with grinding of occlusal contacts once every 3 weeks after TENS procedures, in parallel with Mydocalm 50 mg morning/day, 100 mg at night - 3 weeks, Arcoxia 50 mg/d - 2 weeks, Artra forte 1 tab. 3 t/d - 1 month, Piaskledin 1 tab. (300 mg) 1 t/d - 3 months At the end of the Artra forte course, take Artra for 5 months; 4. Braces for the upper dentition; 5. Occlusion correctors for the lower lateral teeth; 6. Braces for the lower dentition; 7. Separation of the teeth of both jaws; 8. Creation of multiple occlusal contacts by grinding off occlusal correctors; 9. Control EMG; 10. Removal of braces, retention period.*

The results of functional diagnostics, the main stages of orthodontic treatment are presented in figures 4-12.

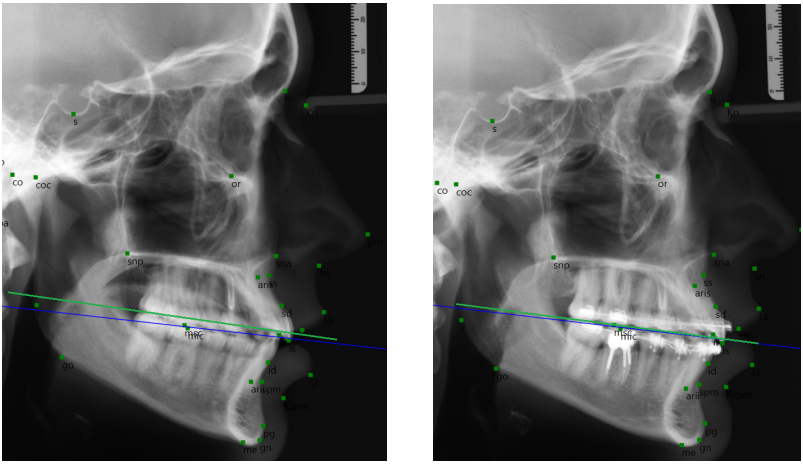


a *b*



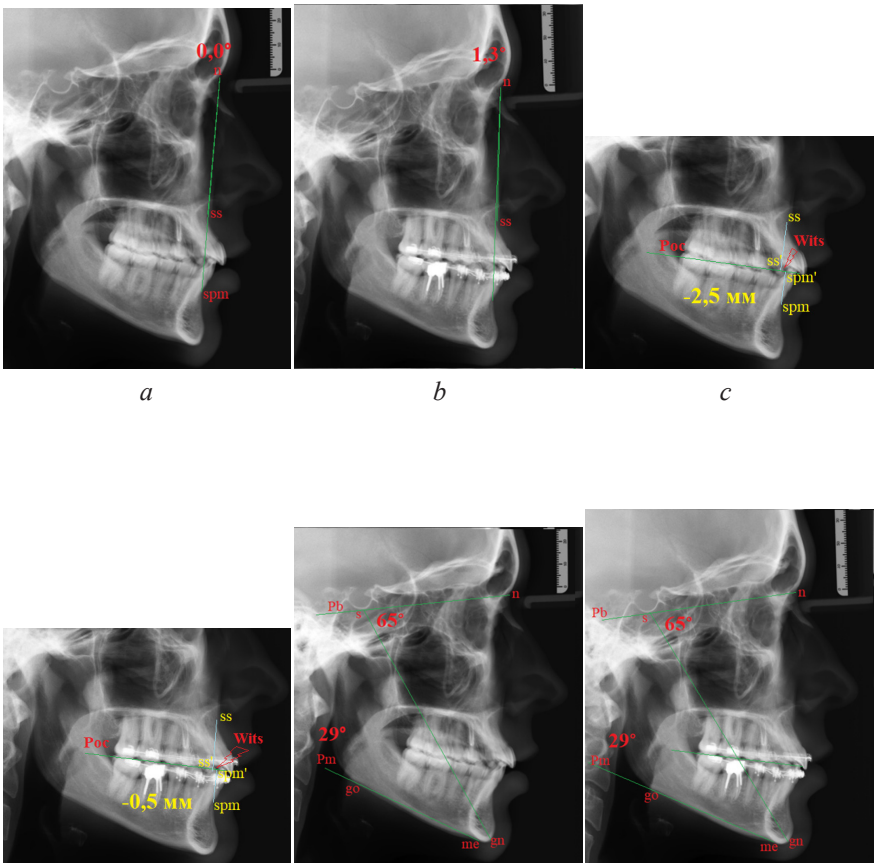
c *d*

Figure 4. *EMG results of patient P.: a – before treatment: fatigue of the left temporal and chewing muscles is determined; b - after the procedure for relaxing the muscles of the maxillofacial area using TENS; c – after using the mouthguard, before fixing the occlusive correctors; d – upon completion of treatment; the positive dynamics of biopotentials, normalization and synchronization of the state of the masticatory and temporal muscles are determined.*



a *b*

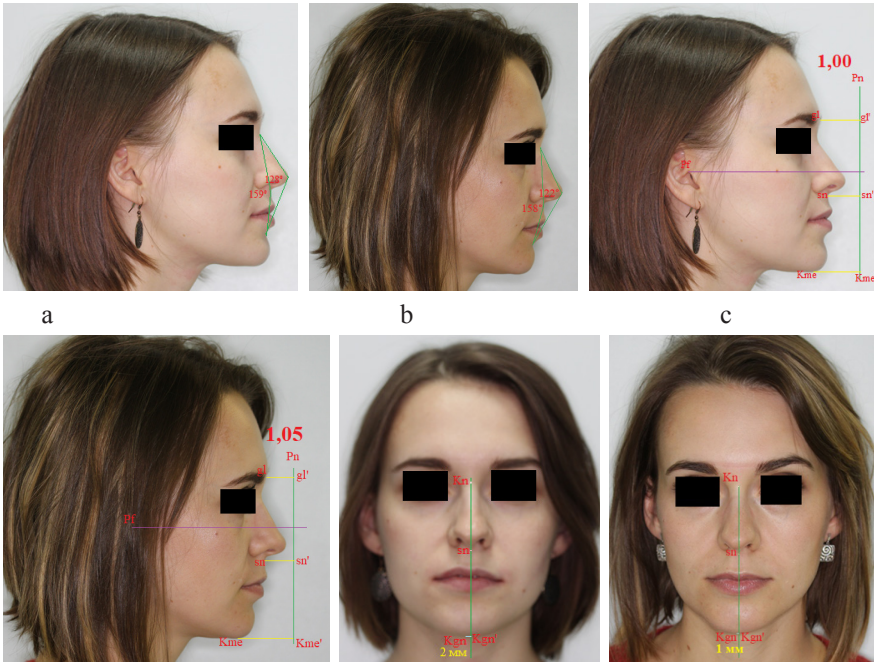
Figure 5. *Lateral TRG of patient P.'s skull before (a) and after (b) treatment: the existing occlusal plane is marked in blue, the optimal occlusal plane is marked in green. At the end of the treatment, the location of the optimal and existing occlusal planes practically coincides*



a *b* *c*

d *e* *f*

Figure 6. *Lateral TRG of patient P.'s skull before (a, c, e) and after (b, d, f) treatment: the value of the angle ss-n-spm corresponds to 1 degree of severity of morphology disorders in the sagittal direction before treatment (a), and the norm - at the end of it (b); the value of the Wits parameter corresponds to 1 degree of severity before treatment (c) and the norm after - its completion (d); the values of the parameters n-s-gn and Pm/Pb correspond to normal (d, f)*



a b c

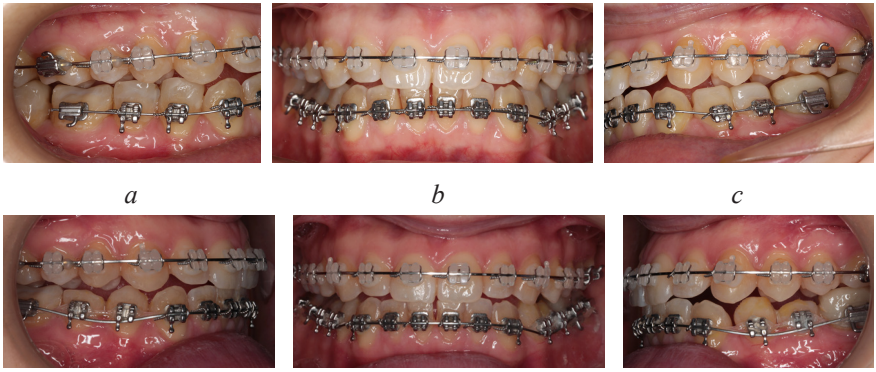
d e f

Figure 7. *Photos of patient P.'s face before (a, c, e) and after (b, d, f) treatment: the value of the Kn-prn-Kspm parameter corresponds to 1 degree of severity of facial aesthetics disorders in the sagittal direction before treatment (a) and norm - at the end of it (b); the values of the ratio gl'-sn'/sn'-Kme (Pn) before and after treatment correspond to normal (c, d); Kgn-Kgn '(Kn-sn) values before and after treatment correspond to grade 1 (e, f)*

a *b* *c*

d *e* *f*

Figure 8. *The dentition of patient P. at the intermediate stage of orthodontic treatment: on the upper jaw there is a bracket system, on the lower jaw - a muscle relaxation mouthguard (a-c); laboratory-made occlusal pads in accordance with the central position of the lower jaw achieved with the help of a tray under the control of EMG (d-f)*



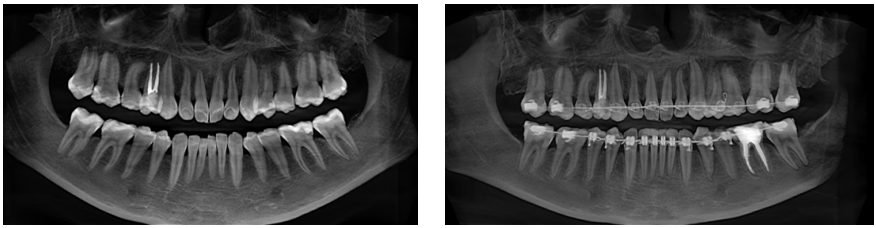
a *b* *c*

d *e* *f*

Figure 9. *The dentition of patient P. at the intermediate stage of orthodontic treatment (a-f): a bracket system is fixed on the teeth of both jaws, on the lower lateral teeth - occlusal overlays, as they grind, the closure of the dentition is normalized in accordance with the central position of lower jaw (g-f)*

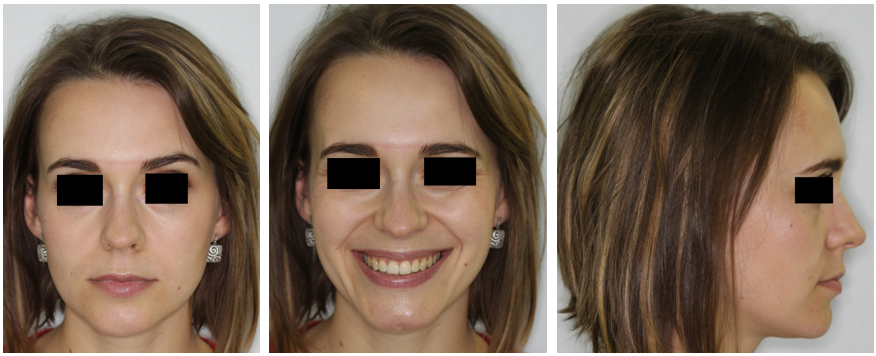
a *b* *c* *d* *e*

Figure 10. *Dentures of patient P. after treatment (a-c)*



a *b*

Figure 11. *CBCT section of patient P.'s dentition before and after treatment (a, b)*



a *b* *c*

Figure 12. *Photos of patient P.'s face after orthodontic treatment (a-c)*

Determination of the effectiveness of the treatment in patient P. (table 1) according to the method of quantitative assessment:AMORF: A2M1O0R0F2+1 → A1M0O0R0F0+0

Before treatment: 6 — 100%

After treatment: 1 − 16,67%

The effectiveness of the treatment performed is interpreted as "significant improvement".

As a result of the treatment, there was a complete elimination of functional disorders, as well as correction of the tight position of the teeth, aesthetic and morphological signs of DAFA in the sagittal direction.

Conclusions

1. In order to select the necessary treatment tactics for patients to achieve the morpho-functional optimum, it is advisable to apply the proposed method of constructing the occlusal plane in the "Allegro" program.

2. The use in clinical practice of the DAFA quantitative assessment method allows, based on the severity of certain signs, to understand its etiology and pathogenesis, on the basis of this, to choose a treatment tactics, and by the change in the severity of signs after treatment, to objectively judge its effectiveness.

References

1. Classification of dentoalveolar anomalies. Quantitative assessment system dentoalveolar-facial anomalies / R.A. Fadeev, A.N. Perepnikova // Publishing house N-L, St. Petersburg 2011, 68 P.

2. Assessment of harmonious development of dentoalveolar system: textbook / L. S. Persin, T. F. Kosyreva // Publishing center "Ortodent", Moscow 1996, – 46 P.

3. Fadeev, R.A. Application of the technique for determining the optimal occlusal plane for the treatment of patients with vertical dentoalveolar anomalies / R.A. Fadeev, E.A. Bulycheva, V.V. Timchenko // MAESTRO Dentistry,2017 - № 2 (66). – P. 74-82.

4. Fadeev, R.A. Prevention of recurrence in the retention period of orthodontic treatment in patients with vertical dentoalveolar anomalies / R.A. Fadeev, V.V. Timchenko // Materials of the International Scientific and Practical Conference "Prevention in Dentistry". – Kazan, 2019. – P. 89-93.

5. Cephalometric diagnosis of dentoalveolar anomalies. Textbook. / R.A. Fadeev, V.V. Timchenko, Yu.P. Litovchenko // Eco-vector Publishing House, St. Petersburg, 2017, – 93 P.

6. Cons, N.C. DAI: The Dental Aesthetic Index. / N.C. Cons, J.Jenny, F.J.Kohout // Iowa City, Iowa: College of Dentistry, University of Iowa; 1986.

7. Daniels, C. The Development of the Index of Complexity, Outcome and Need (ICON) / C. Daniels, S. Richmond // British J. of Orthodontics. – 2000. – №2. – P. 149-162.

8. Method for quantitative assessment of dentofacial anomaliesin child and adolescent orthodontics / R. Fadeev, A. Lanina, P. Li, M. Chibisova, V. Shkarin, N. Prozorova // Archiv euromedica. – 2020. – V.10. – №.2. – P. 76-82.

DOI 10.34660/INF.2020.44.42.013

麻疹患者止血参数的变化
CHANGES IN SOME PARAMETERS OF HEMOSTASIS IN PATIENTS WITH MEASLES

Lazareva Elena Nikolaevna
Doctor of Medical Sciences, Leading Researcher

Aleshina Nina Igorevna
Candidate of Medical Sciences, Senior Researcher

Astrina Olga Semyonovna
Candidate of Biological Sciences, Senior Researcher

Navruzova Luiza Narimanovna
Graduate student

The Central Research Institute of Epidemiology of Rospotrebnadzor, Moscow

注解。 该文章致力于检测和研究成人麻疹患者血小板止血疾病，以检测和预防该疾病的血栓性出血性并发症。 确定D-二聚体，其存在确认过去或当前的血栓形成过程，血小板聚集的速率和程度。

关键词：麻疹，止血，血小板聚集，D-二聚体。

Annotation. *The article is devoted to the detection and study of disorders in platelet hemostasis in adult patients with measles in order to detect and prevent thrombohemorrhagic complications of the disease. The D-dimer was determined, the presence of which confirms the process of past or current thrombosis, the rate and degree of platelet aggregation.*

Keywords: *measles, hemostasis, platelet aggregation, D-dimer.*

Introduction. For a long time in Europe and Russia in particular, measles was considered a rare infection. Sporadic cases of this disease were observed in different countries with different frequency. However, the widespread refusal of vaccinations and the lack of proper control over the timely vaccination of children for many years led to a weakening of the population's immunity. This caused a sharp rise in the incidence of measles. According to the world health organization in Europe (Austria, Bulgaria, Romania, Czech Republic, Belgium, France, Germany, Italy, Portugal, Spain, Switzerland), an increasing number of cases of measles are

registered annually, including among the adult population (more than 2000 per year) [1,2]. Despite the efforts made, the problem remains unresolved. So, in Russia in 2018 compared to 2017 the incidence rate (the number of cases per 100 thousand people) increased by 3.5 times and amounted to 2538 [3].

It is known from the literature that the measles virus is introduced through the mucous membranes of the upper respiratory tract and conjunctiva and then penetrates into human tissues and organs. The input receptor is the CD46 membrane protein expressed by platelets. This fact suggests that platelets play a significant role in the pathogenesis of measles, since the appearance of one of the main pathognomic syndromes of measles – exanthema - leads to the development of hemorrhages, necrosis, which can lead to thrombo-hemorrhagic syndrome. The development of severe complications, such as measles encephalitis, keratitis with complete loss of vision, panencephalitis, pneumonia, as well as a high risk of termination of pregnancy are likely to result from the manifestation of uncapped thrombohemorrhagic syndrome [4,5]. However, according to the literature, the platelet link of hemostasis in patients with measles has not been studied at the current level.

The inclusion of platelet aggregation determination in clinical and laboratory practice will reveal new aspects of measles pathogenesis and serve as a basis for developing preventive measures to prevent thrombohemorrhagic complications in these patients.

Goal. To study the indicators that characterize the functional state of platelets and D-dimers in patients with measles.

Patients and methods. Patients with measles (60 patients diagnosed with measles, verified by the ELISA method, were admitted to the specialized Department of The Infectious Diseases Hospital No. 2 in Moscow in 2017 – 2018).

The patients were 42.8 ± 6.8 years old, 36 males and 24 females. Patients were admitted, on the average, on the 3 - 6 day of the disease during the peak period. Acute onset with febrile status was observed in 71.3% of cases, and in the other cases subfebrile status was registered within 4 days. The duration of the febrile period was 8.5 ± 0.3 days. Examination of patients showed: dry cough (in 80.6% of patients), polylymphadenopathy (in 73.1% of cases), hyperemia and hypertrophy of the tonsils (in 69.4% of patients), as well as hepatomegaly with increased levels of direct bilirubin (6.2%) and transaminase activity (23.8%).

Exanthemic syndrome in the form of roseolesnopapular rash appeared at the height of the disease, on average, on the 4 day, and in 4 subjects on the 6 day, a hemorrhagic component was added, petechiae and a positive "pinch"symptom were registered.

The research was conducted in the clinical Department of infectious pathology of The Central Research Institute of epidemiology of Rospotrebnadzor on the basis of The Infectious Diseases Hospital No. 2 in Moscow.

The control group included 25 practically healthy individuals to assess the physiological level of hemostasis indicators.

Platelet aggregation activity was determined using an aggregometer LA-230 NPO BIOLA (ADP inducer, at a base concentration of 2 x 10^{-5} l), D-dimer - on an automated coagulological analyzer can CS5100, reagent: D-dimer INNOVANCE, "Siemens".

The results of research and discussion. Currently, a direct dependence of hemostasis on pathological disorders of the immune system in many infectious diseases has been established. Activated platelets have been proven to be a powerful and versatile agent of immune and inflammatory effector cells. They establish a link between hemostasis and the immune system by performing recognition, signaling functions, transmitting biological information, and organizing complex physiological and pathological inflammatory reactions. The number of platelets ranged from 93 to 430 x 10^{9}/l, while thrombocytopenia was recorded in 76.1% of cases.

The degree of aggregation was 58.0 ± 2.4% (control - 49.9 ± 3.3%, $p< 0.05$), but more than 40% of patients showed a decrease. Average values of platelet aggregation indicated an increase in their functional activity. However, a quarter of patients showed a decrease in the degree of aggregation, up to 27.4%, among them half — up to 20% or less. At the same time, a quarter of patients were recorded the maximum values of hyperaggregation (80-99%). In 70.6% of cases, the second wave of aggregation was registered, including among patients with reduced indicators of the degree and speed of aggregation. It is important to note that in patients with the presence of single petechiae, platelet aggregation was reduced, on average, to 20% and there was no second wave on the aggregatogram, the presence of which indicates the functional safety of platelets.

The D-dimer test is a definitive study for suspected thrombotic disorders [6]. An increase in the concentration of D-dimers above the average values in this study was recorded in the vast majority of patients (1340 ± 58 ng/ml, control 468 ± 20 ng/ml, $p<0.001$), while in 35% of cases the values were significantly higher than 1000 ng/ ml, which indicates the risk of increased thrombosis.

Conclusion. The results of this study showed that the development of the infectious process in the body of patients with measles is accompanied by pronounced disorders in the platelet hemostasis link. It is also impossible to exclude the fact of isolation of the measles virus by platelets as the primary barrier to the introduction of the pathogen. These processes require increased consumption of blood plates, so by the time the rash appears, there is a platelet deficiency, manifested by thrombocytopenia, but the cells retain functional activity with a moderate increase in it. However, the detection of platelet Hypo-aggregation in some cases gives reason to consider the depletion of platelet growth, which may affect the development of hemorrhagic syndrome in these patients.

Thus, currently, patients with measles have disorders of the platelet hemostasis link, and they can be decisive for the severity of the course and outcomes of the disease. Therefore, to determine the risk criteria for complications from hemostasis, as well as for the prognosis of the disease, it is necessary to continue further, more detailed study of the dynamics of all hemostasis links in patients with measles.

References

1. Elimination of measles in the WHO European Regionchallenges persist. Muscat M, Ben Mamou M, Singh S, de Kat C, Jankovic D, Huseynov S, Deshevoi S, Datta S, O'Connor P. Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz. 2019 Mar 18. doi: 10.1007/s00103019029202.

2. Measles-related hospitalizations in Italy, 2004-2016: the importance of high vaccination coverage.Fiasco F, Nakasone C, Fabiani L, Mastrodomenico M, J.-B. Mattei.Ann Health Globe. 2019 March 19;85(1). PD: 40. DOI: 10.5334 / aogh. 2455.

3. Measles in adults Poniewa J. B., Arakelyan A. K., Kozlova M. S., Vdovina E. T. Epidemiology and infectious diseases. Topical issue. 2018. No. 2. P. 5055.

4. Could this be measles? O'donnell S, Davies F Vardhan M, Nee P. Chief Med J. 2019 April 3. personal data: emermed2019208490. doi number: 10.1136/ emermed2019208490

5. S. J. Russell, K. W. Peng, measles virus for cancer therapy / Current microbiol immunol, 2009; 330: 213-241.

6. In D-dimer analysis. Johnson ed, shell JC, Rogers гм.Ам J Hematol. 2019 Apr 4.doi: 10.1002/ajh.25482.

DOI 10.34660/INF.2020.92.78.014

过敏性疾病和幽门螺杆菌感染
ALLERGIC DISEASES AND *HELICOBACTER PYLORI* INFECTION

Mazurina Svetlana Alexandrovna
Candidate of Biological Sciences, Lead Research Officer
I.I. Mechnikov Scientific Research Institute of Vaccines and Serums
Gervazieva Valentina Borisovna
Doctor of Medical Sciences, Head of Laboratory.
I.I. Mechnikov Scientific Research Institute of Vaccines and Serums
Sveranovskaya Valeriya Veniaminovna
Candidate of Medical Sciences, Senior Research Officer of the Laboratory of allergy diagnostics of the FSBSI
I.I. Mechnikov Scientific Research Institute of Vaccines and Serums
Moscow, Russia

抽象。用ELISA法测定患有过敏性疾病并伴有胃病的儿童血清中共原纤维蛋白中H.pylori和细胞因子IL-4和IL-10的总IgE，IgG-，IgA-和sIgE-的含量抗幽门螺杆菌及其抗原CagA的CagA，IL-17，sIgA和sIgE。研究表明，在总IgE水平升高的背景下，患有过敏和慢性胃十二指肠炎（CGD）的儿童中，血清中的抗幽门螺杆菌IgE反应高于IgA和IgG反应，而针对幽门螺杆菌的sIgE水平却升高加剧过敏。在患有GIT黏膜糜烂和溃疡性病变的儿童以及没有过敏的CGD儿童中，幽门螺杆菌的sIgE检出率和水平明显低于健康儿童。在没有过敏的慢性胃十二指肠炎患儿中检测到的最高IL-17和sIgA水平与确诊的幽门螺杆菌感染有关。同时，在以变应性疾病为背景的慢性胃十二指肠炎患儿和粘膜糜烂和溃疡性病变患儿中，sIgE对幽门螺杆菌产生了分泌性免疫反应，幽门螺杆菌的含量更高。我们的数据表明sIgE对幽门螺杆菌的保护作用，与过敏性和胃十二指肠病理的良好进程相关。

关键词：过敏，慢性胃十二指肠炎，幽门螺杆菌和CagA的sIgE

Abstract. *In children with allergic diseases and concomitant gastropathology by ELISA, the content of total IgE, IgG-, IgA- and sIgE- to H.pylori and cytokines IL-4 and IL-10 was determined in blood serum, in coprofiltrates - the content of CagA, IL-17, sIgA and sIgE against H.pylori and its antigen CagA. It was shown that in children with allergies and chronic gastroduodenitis (CGD) against the background of an increased level of total IgE, the anti-Helicobacter IgE response in serum prevailed over IgA and IgG responses, while the level of sIgE*

to H.pylori increased with exacerbation of allergy. In children with erosive and ulcerative lesions of the GIT mucosa and in children with CGD without allergy, the detection rate and level of sIgE to H.pylori were significantly lower than in healthy children. The highest levels of IL-17 and sIgA, detected in children with chronic gastroduodenitis without allergy, were associated with confirmed H.pylori infection. At the same time, in children with chronic gstroduodenitis against the background of allergic diseases and in children with erosive and ulcerative lesions of the mucous membrane, the secretory immune response was presented by sIgE to H.pylori, its higher content in the latter. Our data indicate a protective role of sIgE against H.pylori, associated with a favorable course of allergic and gastroduodenal pathology.

Keywords: *allergy, chronic gastroduodenitis, sIgE to H. pylori and CagA*

Introduction

The high prevalence and steady increase in the number of allergic diseases in recent decades are the subject of study in various international clinical, immunological and epidemiological studies. According to the ISAAC study, the prevalence of asthma among children 6-7 years of age in different countries varies from 4.1 to 32.1% with the greatest prevalence in the UK, North America, Australia and Western Europe. Lower rates are found among children in the Baltic and Central European countries, while the lowest rates were found in Eastern European countries. In our country, 10 to 15% of the population suffer from allergic diseases. The same picture of the "geographic gradient" in the prevalence of asthma is observed among children 13-14 years old, while the prevalence of asthma in Western Europe is 20 times higher than in Eastern Europe, varying, on average, from 36.8 to 1. 6%, respectively. This scatter of data is explained by the "hygienic hypothesis", according to which the increase in the number of patients with allergic diseases is associated with the civilizational "Western way of life."

In accordance with the hygienic hypothesis, much attention of researchers is paid to the role of the microbiome in the development of chronic inflammation, to which *Helicobacter pylori* also applies. This microbe is widespread in the world, including in Russia, where, according to epidemiological data, more than 80% of the adult population are infected. *H.pylori*-associated gastritis accounts for 90% of all forms of chronic inflammation of the gastric mucosa. As a natural symbiont, *H.pylori* has evolved towards switching the adaptive immune response of the gastric mucosa to immune tolerance, which has allowed the bacteria to persist for decades in infected individuals and contribute to chronic infection.

In 2008, Blaser M and Chen Y [1] found that early *H.pylori* colonization of the gastric mucosa correlated inversely with the prevalence of asthma in children, and hypothesized that infection of children with this microbe protects against asthma.

Since then, many prospective, retrospective cohort, "case-control" studies have been carried out in the world, the meta-analysis of which generally confirmed the discovered pattern in children, but not in adults [2,3].

The biological mechanism proposed to explain the preventive effect of *H.pylori* on allergy is to reduce the antigenic stimulus for the generation of Treg cells in individuals without *H.pylori* infection. The lack of adequate stimulation of Th1 cells with a reduced function of innate immunity and its Treg cells contributes to the polarization of the immune response towards the hyperfunction of Th2 cells, mediating the IgE response [4]. New data were obtained on the role of local immunity of the mucous membranes in the development of chronic gastritis with persistence of *H.pylori* and its inverse association with atopy and asthma [5]. The regulatory role of natural CD4 + CD25 + FoxP3 Treg cells and cytokines IL-10 and TGF-β in suppression of the adaptive Th1/Th17 response characteristic of acute gastritis has been shown [6]. It also turned out that under conditions of total IgE deficiency (>2 kU/l) *H.pylori* infection has a more severe course with the development of erosive-ulcerative gastroduodenitis in children [7]. The role of secretory IgA (sIgA) is well known in protection against pathogens in CO, the secretory component of which is not destroyed by proteolytic enzymes. In the subclinical course of *H.pylori* infection, antigenic stimulation may be insufficient for detectable sIgA levels. IgE, a phylogenetically more ancient immunoglobulin that protects CO, and, unlike other immunoglobulin isotypes, is initiated primarily by low doses of naturally secreted antigens by persistent microorganisms, which include *H.pylori*. The presence of IgE-producing plasma cells in the GIT mucosa was found in peptic ulcer and erosions of the gastric and/or duodenal ulcer mucosa (DU) associated with *H.pylori* infection, including in individuals with allergic diseases [8,9]. However, the role of IgE in humoral and secretory anti-Helicobacter immunity has not been studied for a long time and has not been definitively determined.

In this regard, the aim of the work was to evaluate the IgE humoral and secretory immune response to *H.pylori* and its CagA-AG in children with chronic inflammatory diseases of the gastroduodenal zone associated with atopic reactivity.

Materials and methods

In total, there were 83 children in the study (the average age was Me = 14 (12; 16) years). 69 children had chronic inflammatory diseases of the stomach and/or DU in the acute stage, 14 apparently healthy children formed the control group. In addition to gastropathology (group I), 22 children were diagnosed with bronchial asthma, atopic dermatitis or allergic rhinitis. 12 children with chronic gastritis/ gastroduodenitis (CGD) without allergy made up group II of the study and 35 children with erosions of the gastric mucosa and peptic ulcer DU - group III. The presence of *H.pylori* infection was confirmed in 45% of children of group I, 75% of children of group II and 66% of children of group III by breathing and rapid ure-

ase tests, the nature of the lesion of the mucous membrane of the gastroduodenal zone was established by the results of EGDS.

By ELISA, the content of total IgE, IgG-, IgA- to *H.pylori* and cytokines IL-4 and IL-10 were determined in the blood sera of patients using commercial test systems. sIgE to *H.pylori* - using a conjugate of monoclonal anti-IgE-AT (LLC "Polignost") and IgE-reference reagents from Dr. Fooke "(Germany). As a solid phase, plates with *H.pylori* corpuscular antigen (ELISA-Helicobacter-IgG CJSC "ECOlab") were used. The content of sIgA in saliva, the level of IL-17 in the supernatants of fecal samples (coprofiltrates) were assessed using commercial kits from AO Vector-Best (Russia). The concentration of CagA, sIgE to *H.pylori* and its antigen CagA was also determined by ELISA using recombinant rCagA fr4, monoclonal antibodies to it, conjugate of monoclonal anti-IgE-antibodies (LLC Polignost St. Petersburg) and IgE reference reagents from "Dr. Fooke" (Germany). As a solid phase, plates with *H.pylori* corpuscular antigen (ELISA-Helicobacter-IgG CJSC "ECOlab") and adsorbed with rCagA fr4 antigen at a concentration of 1 μg/ml were used. Statistical processing was performed using the Statistica 10.0 software package.

Results

To characterize the humoral immune response to *H.pylori* in sick and healthy children, anti-Helicobacter antibodies of IgG, IgA, and IgE isotypes were determined. IgG-AT were detected both in the blood of patients (40%, 50%, 43% in groups I, II and III) and healthy individuals (50%), which indirectly indicates a wide spread of infection among schoolchildren. At the same time, the titers of IgG-AT to *H.pylori* (1:208; 1:208; 1:194; 1:208) were practically the same in all groups of children. IgA-antibodies to *H.pylori* were determined with various frequencies in children with allergies (20%) and without it (83% in group II and 57% in group III) and in healthy children (43%), and IgA titers Abs to *H.pylori* in the blood serum of healthy individuals were lower than in sick children.

The frequency of detection of sIgE to *H.pylori* in sera was the highest in healthy children (86%) and decreased in children with CGD of 2 groups from 75% to 65% (group I). In children with ulcerative erosive lesions of the mucous membrane, the sIgE detection rate was 54%. The concentration of sIgE to *H.pylori* was significantly higher in children with concomitant allergic diseases and amounted to Me = 1.84 (0.96; 3.01) IU/ml, in comparison with the other two groups [0.85 (0.6; 1.13) IU/ml and 0.87 (0.71; 1.48) IU/ml]. Moreover, in children with CGD and allergopathology with an exacerbation of the allergic process, the concentration of sIgE to *H.pylori* in serum increased [2.99 (1.12; 3.53) IU/ml] and was significantly higher than in remission of the disease [0.96 (0.8; 2.5) IU/ml, $p<0.05$]. Separately, the content of serum sIgE to *H.pylori* was analyzed in patients with a history of repeated courses of *H.pylori* eradication without the desired effect. It turned out

that sIgE in the sera of these children are determined less frequently (30%) and at a lower concentration [0.71 (0.6; 0.98) IU/ml versus 2.8 (1.6; 3.4) IU/ml in healthy people, p = 0.005].

As for the levels of cytokines, IL-4 was detected only in the sera of children with erosive and ulcerative lesions of the mucous membrane [2.97 (1.09; 4.3) pg/ml], while IL-10 was detected in all children: 11.6 (6.8; 16.5) pg/ml - group I, 9.4 (4.5; 14.8) pg/ml - group II, with a significantly higher concentration in children with ulcerative erosive gastritis 17.8 (15.1; 25.1) pg/ml, p <0.05.

In secretory immunity in children with CGD without allergy (groups II and III), the level of sIgA in saliva exceeded normal values (57-260 μg/ml) in 50% and 66% of cases [Me = 2247 (81; 4000) μg/ml and 1465 (131; 1463) μg/ml]. In children with allergic pathology, increased levels of sIgA were noted less frequently (15%), and their concentration was lower [140.8 (12.7; 550.7) μg/ml] than in children without allergies. In the supernatants of feces samples, the sIgA level in children with CGD without allergy was higher [18.2 (13.3; 31.2) μg/ml, p = 0.023] than in children with allergies and in children with erosive and ulcerative lesions SD of the stomach [8.5 (0; 18.04) μg/ml; 7 (0; 19.2) μg/ml]. At the same time, the increased content of sIgA in coprofiltrates in children with CGD without allergy correlated with confirmed *H.pylori* infection (R = 0.64, p = 0.04). It turned out that the level of IL-17 in the intestinal secretion of these children was significantly higher [37.7 (33.8; 42.1) pg/ml, p = 0.005] than in children with allergies and in children with erosive and ulcerative lesions. RM of the gastroduodenal zone [9.62 (6.3; 19.7) pg/ml; 17.76 (6.92; 26.5) pg/ml].

Detection of CagA in coprofiltrates was 43% in children of group I, 30% in group II and 57% of children in group III. Moreover, its concentration in children with positive urease activity was significantly higher than that in children with negative activity [1 (0.6; 1.5) μg/ml and 0.5 (0.4; 0.6) μg/ml]. It can be assumed that low concentrations of *H.pylori* CagA correspond to a low degree of contamination of *H.pylori* mucosa, which does not give positive results in urease research methods.

Of particular interest was the determination of sIgE to *H.pylori* in the intestinal contents, since more than 90% of all IgE is secreted through the GIT epithelium, where it performs its protective role against pathogens. It turned out that in the supernatant of fecal samples in children with CGD sIgE to *H.pylori* and its CagA are determined with a high frequency, respectively, in 89% and 65% of cases in group I, in 100% and 58% of cases in group II, in 97% and 77% - in group III, and the highest content of sIgE to *H.pylori* [Me = 4.6 (2.0; 5.4) IU/ml] is detected in children with erosive and ulcerative lesions of gastric mucosa and DU (p = 0.04) compared with children of the other two groups [2.3 (0.4; 8.7) IU/ml and 3.2 (2.2; 10.2) IU/ml, respectively]. The level of sIgE to CagA *H.pylori* practically did not

differ in all the studied groups [1.5 (0.7; 2.4); 1.2 (0.6; 1.3); 1.4 (1.1; 2.0) IU/ml]. In children with CGD and allergies, a direct correlation was found between serum sIgE to *H.pylori* and secretory sIgE in intestinal secretions ($R = 0.59$, $\rho = 0.01$) and an inverse relationship with sIgA ($R = - 0.52$, $p = 0.029$), which is generally characteristic of the immune response in allergies.

Conclusion

As a result of the study, we revealed differences in the content of sIgE to *H.pylori*, depending on the nature of the lesion of the gastric mucosa/DU and the presence of allergies. In children with allergic diseases against the background of an increased level of total IgE, the synthesis of sIgE to *H.pylori* prevails over the IgA response due to the atopic orientation of the immune response. In children with CGD without atopy, the synthesis of sIgE to *H.pylori* is due to the switching of the immune response to the Th2 type, which determines the long-term persistence of the microbe in the gastric mucosa. At the same time, the favorable course of CGD is accompanied by a low level of sIgE, while erosive and ulcerative processes in CO are characterized by an insufficient level of sIgE, even against the background of an increased content of IL-4. The decrease in the activity of the immune response in *H.pylori* infection is compensated by the high level of IL-10.

Children with chronic gastroduodenitis without allergies were found to have increased levels of sIgA and IL-17, indicating the involvement of Th1 / Th17 in the secretory immune response to *H.pylori* infection. At the same time, in children with allergic diseases and chronic gastroduodenitis, as well as in children with erosive and ulcerative lesions of the gastric mucosa, the immune response is predominantly sIgE to *H.pylori* and its CagA, with a higher content of these antibodies in the latter, which may indicate switching secretory immunity to the Th2 type of response, which, using sIgE, along with sIgA, has a protective role in *H.pylori*-associated infection of the gastrointestinal mucosa.

Thus, under conditions of chronic inflammation of the mucous membrane of the gastroduodenal zone, the production of sIgE to *H.pylori* is associated with a favorable course of gastroduodenal and allergic pathology and can be regarded as a protective reaction of the body.

References

1. Blaser MJ, Chen Y, Reibman J. Does Helicobacter pylori protect against asthma and allergy? Gut 2008; 57: 561-567

2. Taye B, Enquselassie F, Tsegaye A, Medhin G, Davey G, Venn A. Is Helicobacter Pylori infection inversely associated with atopy? A systematic review and meta-analysis. Clin Exp Allergy. 2015; 45:882–890.

3. Lionetti E., Leonardi S., LanzafameA et al. Helicobacter pylori infection and atopic diseases: Is there a relationship? A systematic review and meta-analysis. World J Gastroenterol. 2014; 20(46): 17635-17647.

4. Rad R1, Brenner L, Bauer S, et al. CD25+/Foxp3+ T cells regulate gastric inflammation and Helicobacter pylori colonization in vivo. Gastroenterology. 2006;131(2):525-37.

5. Lee SP, Lee SY, Kim JH, et al. Correlation between Helicobacter pylori infection, IgE hypersensitivity, and allergic disease in Korean adults. Helicobacter. 2015; 20(1): 49-55.

6. Hussain K., Letley D.P., Greenaway A.B., Winter J.A. et al. Helicobacter pylori-mediated protection from allergy is associated with Il-10-secreting peripheral blood regulatory T cells. Front. Immunol. 2016; 7: 71-86.

7. Magen E, Schlesinger M, David M, Ben-Zion I, Vardy D. Selective IgE deficiency, immune dysregulation, and autoimmunity. Allergy Asthma Proc 2014; 35: e27-e33

8. Berczi L., Sebestyen A., Fekete B., Tamassy K., Kopper L. IgE-containing cells in gastric mucosa with and without Helicobacter pylori infection. 2000; 196 (12): 831 –834.

9. Kanareitseva T. D. Chernutskaya S. P. Gervazieva V. B. Sukhareva G. V. Morphoimmunological criteria for the diagnosis of gastritis associated with Helicobacter pylori. Experimental and Clinical Gastroenterology,2010; 2:22-26.

中年人锂缺乏症的认知功能障碍
COGNITIVE DYSFUNCTION IN LITHIUM DEFICIENCY IN MIDDLE-AGED INDIVIDUALS

Pepelyaev Evgeny Gennadievich
Postgraduate
Kemerovo State Medical University
Kemerovo, Russia
Semenov Vladimir Alexandrovich
Doctor of Medical Sciences, Full Professor
Kemerovo State Medical University
Kemerovo, Russia
Gromova Olga Alekseevna
Doctor of Medical Science, Full Professor
Ivanovo State Medical Academy
Ivanovo, Russia

抽象。本文介绍了锂水平及其对中年人认知领域的影响的研究结果。对平均年龄为52岁的患者进行了随访，其中46％为男性（n = 92）。参加者分为两组。在随访组（n = 100）中，患者接受了标准疗法和有机抗坏血酸锂盐（0.78mg /天元素锂）治疗八周。在对照组（n = 100）中，患者仅接受标准疗法。通过使用抗坏血酸锂的过程，揭示了对神经心理学测试结果（舒尔特表，MMSE量表，A.R。Luria技术，视觉空间诊断，BDI）和血浆BDNF水平的影响。因此，将锂微量营养素与标准疗法结合使用可显着提高BDNF水平，改善记忆力，改善睡眠并减少头痛和头晕形式的脑脊髓疾病。

关键字：锂； BDNF；神经心理测试；认知功能障碍

Abstract. *The article presents the results of a study of lithium levels and its effect on the cognitive sphere in middle-aged individuals. Patients with an average age of 52 years were followed up, 46% of them men (n = 92). The participants were divided into two groups. In the follow-up group (n = 100), patients took standard therapy and organic lithium ascorbate salt (0.78mg/day elemental lithium) for eight weeks. In the control group (n = 100), patients received only standard therapy. With the course use of lithium ascorbate, an influence was revealed on the results of neuropsychological testing (Schulte table, MMSE scales, A.R. Luria technique, visual-spatial gnosis, BDI) and blood plasma BDNF level. Thus, the*

use of lithium micronutrient in conjunction with standard therapy contributed to a significant increase in BDNF levels, improved memory, sleep, and reduced cerebrospinal disorders in the form of headaches and dizziness.

Keywords: *lithium; BDNF; neuropsychological testing; cognitive dysfunction*

Introduction

One of the important tasks of modern healthcare is to slow down the progression of cognitive impairment. In particular, slowing the transition from mild to moderate cognitive impairment. However, a rather alarming fact is that up to 24% of people over 60 years old have changes that meet the criteria for moderate cognitive impairment [1]. It is important to note that 10-15% of patients with manifestations of moderate cognitive impairment develop dementia within one year, leading to a partial or complete loss of independence and self-care of the patient in social and professional spheres [2].

Timely detection of the transformation of "mild" cognitive impairments into "moderate" cognitive impairments is very important. Due to the fact that not timely diagnosed "mild" smoothly transform into "moderate" ones and then into dementia [3].

The impairment of cognitive function is facilitated by a wide variety of mental disorders, which are caused not only by organic damage to the brain, but also by impaired metabolic processes, including the elemental composition [4]. Currently, the issue of the impact of trace elements on cognitive function is relevant.

Among the factors that can control the metabolism of brain cells under conditions of hypoxia, the brain neurotrophic factor (BDNF) is distinguished, which acts through the LNGFR TrkB receptors [5]. The neurotrophic factor of the brain has a wide range of functional properties and neuroplasticity, i.e. promotes the survival of brain cells. The neurotrophic factor of the brain is involved in the differentiation of neurons, synaptogenesis, and neuroprotection during development [6]. The activity and levels of BDNF content depend not only on the levels of peptide factors and amino acids [7], but also on the provision of the patient with such micronutrients as lithium [8, 9]. In studies in vitro [10] in vivo [10, 11], it was found that lithium ascorbate can exhibit adaptogenic and neuroprotective effects.

Materials and methods

The study involved, after signing informed consent, patients (n = 200) with an average age of 52 years, of which 46% were men. The total number of patients was divided into two groups: observation group (n = 100) - patients with standard therapy (vascular, nootropic) + lithium ascorbate at a dose of 780 μg/day for two months; control group (n = 100) - patients with standard therapy (vascular, nootropic).

The groups are comparable in gender, age, work and educational status, bad

habits, quality of life, neuropsychological testing indicators, BDNF and lithium levels.

The exclusion criteria were pregnancy, lactation, a history of craniocerebral trauma, acute cerebrovascular accidents, severe diabetes mellitus, hepatic, renal, cardiovascular failure, and oncological diseases.

We used: questionnaire "quality of life - neurological module", depression scale BDI, methodology of A.R. Luria "10 words", "Schulte table" technique, a short scale for assessing mental status, a technique for studying visual-spatial gnosis. Testing was carried out in the morning from 8 am to 10 am on a full stomach.

All patients underwent determination of the Li level in the hair composition at the beginning of the study and after two months.

All patients underwent blood sampling to study the level of BDNF. To study the level of BDNF in blood plasma based on the quantitative enzyme-linked immunosorbent assay of the sandwich type by the enzyme-linked immunosorbent assay (ELISA).

RFBR grant №19-07-00356.

For the standard processing of the research results, the methods of mathematical statistics were used, including the calculation of the numerical characteristics of random variables, testing statistical hypotheses using parametric and nonparametric criteria, correlation and analysis of variance. Comparison of the predicted and observed frequencies of occurrence of the studied characters was carried out using the chi-square test, Wilcoxon's T-test, Mann-Whitney U-test and Student's t test. The application program STATISTICA 10.0 and Microsoft Excel spreadsheets were used. During statistical processing of the data, differences were considered significant at $p \leq 0.05$.

Results

Analysis of the condition of patients in the control group during treatment allowed to establish the effects of standard therapy (Table 1). A significant decrease in the score of visual-spatial gnosis ($p \leq 0.05$) and an improvement in mood ($p \leq 0.05$) was found in the absence of significant changes in the level of the microelement lithium and neurotrophic factor of the brain.

Table 1. *Analysis of the dynamics of the state of patients in the control group.*

indicator	baseline (%, average, interval range)	after 2 months (%, average, interval range)	p
depression scale	9,34; 4-13	7,13;3-11	≤0,05
visual-spatial gnosis	7,23; 7-8	6,9; 6-8	≤0,05
complaints of decreased mood (%)	41	34	≤0,05
BDNF	27507,93; 24225-29875	28383,3; 25276-30218	>0,05
Li	0,01; 0,01-0,02	0,01; 0,01-0,02	>0,05

Analysis of the condition of patients in the observation group over time showed that the addition of standard therapy with lithium ascorbate led to significant differences in the dynamics of treatment compared to the dynamics in the control group (Table 2).

Table 2. *Dynamics of the state of patients in the observation group.*

indicator	baseline (%, average, interval range)	after 2 months (%, average, interval range)	p
quality of life	15,58; 14-17	16,35; 15-18	≤0,05
depression scale	9,88; 6-12	5,48; 2-8	≤0,05
methodology 10 words	3,33; 3-4	3,7; 3-4	≤0,05
Schulte table (work efficiency)	2,7; 2-3	3,03; 2-4	≤0,05
Schulte table (mental stability)	1,06; 1-1,2	0,99; 0,9-1,1	≤0,05
MMSE	25,84; 25-27	26,82; 26-28	≤0,05
visual-spatial gnosis	7,17; 6-8	8,09; 8-9	≤0,05
complaints of decreased memory (%)	38	26	≤0,05
complaints of decreased performance (%)	36	24	≤0,05
cerebral complaints (%)	54	39	≤0,05
sleep disorders (%)	15	8	≤0,05
BDNF	27622,39; 24644-31123	31510,24; 28173-36198	≤0,05
Li	0,01; 0,01-0,02	0,02; 0,02-0,02	≤0,05

One of the important results of the study of the effects of lithium ascorbate was an increase in lithium levels in the hair ($p \leq 0.05$), accompanied by an increase in the levels of the neurotrophic factor BDNF in the blood ($p \leq 0.05$). Against this background, there is a significant increase in the quality of life of patients ($p \leq 0.05$), a decrease in the Beck Depression Scale ($p \leq 0.05$), an increase in the score on memorizing 10 words ($p \leq 0.05$), an increase in the score of the short scale of assessment of mental status ($p \leq 0.05$). Subjectively, there was a significant decrease in complaints of poor memory ($p \leq 0.05$), low performance ($p \leq 0.05$), poor sleep ($p \leq 0.05$), headaches and dizziness ($p \leq 0.05$).

Conclusion

In the present study, the use of ultra-low doses of the microelement lithium in the form of lithium ascorbate in addition to standard therapy (less than 1 mg/day calculated on elemental lithium) was studied. This observation showed a significant increase in the level of BDNF, a decrease in the manifestation of cognitive

dysfunction in the form of an improvement in the results of neuropsychological testing, as well as an improvement in the subjective feeling of the health of patients in the form of an increase in working capacity, improved memory, improved sleep and a decrease in general cerebral disorders in the form of headaches and dizziness.

References

1. Starchina YuA, Parfyonov WA. Cognitive frustration at tserebrovaskulyarny diseases: diagnosis and treatment. RMJ. Neurology. 2008;16(12):1–3. (In Russ).

2. Petersen RS, Smith GE, Waring SC, et al. Mild cognitive impairment: clinical characterization and outcome. Arch. Neurol. 1999;56:303–308.

3. Parfyonov WA, Zakharov VV, Preobrazhenskiy IS. Cognitive frustration. Moscow: Group Remedium, 2014. 192 pages. (In Russ).

4. Yahno N.N., Koberskaya N.N., Damulin I.V. et al. Organization of care for patients with memory impairment and other cognitive functions//Neurological journal. 2006; 11(1): 75-79. (In Russ).

5. Leibrock J, Lottspeich F, Hohn A, et al. Molecular cloning and expression of brain-derived neurotrophic factor. Nature. 1989;34(1):149–152.

6. Castren E, Vaikar V, Rantamaki T. Role of neurotrophic factors in depression. Curr. Opin. Pharmacol. 2007;7(1):18–21. DOI: https://doi.org/10.1016/j.coph.2006.08.009

7. Serkina EV, Gromova OA, Torshin Yu, et al. Cerebrolysin alleviates perinatal CNS disorders through the autoimmune modulation and antioxidant protection. Journal of neurology and psychiatry S.S. Korsakov. 2008;108(11):62–66. (In Russ).

8. Torshin IYu, Gromova OA, Mayorova LA, Volkov AY. Targeted proteins involved in the neuroprotective effects of lithium citrate. Neurology, Neuropsychiatry, Psychosomatics. 2017; 9(1):78–83. (In Russ). DOI: http://dx.doi.org/10.14412/2074-2711-2017-1-78-83

9. Torshin IYu, Gromova OA, Kovrazhkina EA, et al. Data mining of the interactions between the trace element composition of the blood and the state of the patients with the lateral amyotrophic sclerosis shown lowered levels of lithium and selenium. Consilium Medicum. 2017;19(9):88–96. (In Russ). DOI: 10.26442/2075-1753_19.9.88-96

10. Ostrenko KS, Gromova OA, Pronin VA, et al. Neuroprotective and adaptogenic effects of lithium ascorbate: studies on in vivo models and in vitro. Problems of biology of productive animals. 2017;3: 37–47. (In Russ).

11. Ostrenko KV, Gromova OA, Sardaryan IS, et al. The effectiveness of lithium ascorbate on chronic alcohol intoxication model. Pharmacokinetics and pharmacodynamics. 2017;1:11–21. (In Russ).

DOI 10.34660/INF.2020.85.17.016

喀山患者慢性自发性荨麻疹的临床和致病性变异

CLINICAL AND PATHOGENETIC VARIANTS OF CHRONIC SPONTANEOUS URTICARIA IN PATIENTS OF KAZAN

Sibgatullina Nailya Askhatovna
Candidate of Medical Sciences,
Assistant at the Department of Allergology and Immunology
of the KSMA-branch of FSBEI APE RMACPE of the Ministry
of Health of Russia, Kazan
Delian Victoria Yurievna
Candidate of Medical Sciences, Associate Professor,
Acting Head of the Department of Allergology and Immunology
of the KSMA-branch of FSBEI APE RMACPE of the Ministry
of Health of Russia, Kazan
Mazurina Svetlana Alexandrovna
Candidate of Biological Sciences,
Lead Research Officer of the Allergy Diagnostic Laboratory
of the I.I. Mechnikov Scientific Research Institute of Vaccines and
Serums, Moscow

抽象。本文提供了有关喀山患者慢性自发性荨麻疹的病因和病因方面的详细数据。特别注意荨麻疹和蠕虫病的自身免疫变体的机制。

该研究包括119名18至63岁的CSU患者，比较组包括10名AU患者，10名无荨麻疹的AIT患者以及27名25至40岁的健康志愿者。所有患者均接受了完整的临床和实验室检查，包括回忆记录的收集，检查，用自体血清进行皮内试验，一般血球计数，尿液分析；肝，胆，胰的超声检查；纤维十二指肠镜（FGDS），十二指肠插管；粪便的羊膜囊肿分析，免疫学和过敏学检查。

研究结果表明，在大多数患者中，CSU是在包括寄生虫（肠道贾第鞭毛虫病）和自身免疫性疾病（自身免疫性甲状腺炎）在内的慢性疾病的背景下出现的。同时，在疾病持续时间长达1年的情况下，更经常检测到抗甲状腺抗体水平升高和总IgE以及ASKP阳性。揭示了对羔羊的IgE免疫反应与总IgE水平升高（68.75％）和ASKP阴性（62.5％）高度相关。

关键字：CSU，AIT，贾第鞭毛虫病，自体皮肤测试，IgE。

Abstract. *The article provides detailed data on the etiological and pathogenetic aspects of chronic spontaneous urticaria in patients of Kazan. Special attention is*

paid to the mechanisms of the autoimmune variant of urticaria and helminthiasis.

The study included 119 patients with CSU aged 18 to 63 years, the comparison groups consisted of 10 patients with AU, 10 patients with AIT without urticaria, and 27 healthy volunteers aged 25 to 40 years. All patients underwent a complete clinical and laboratory examination, including the collection of anamnesis data, examination, setting an intradermal test with autologous serum, general blood count, urinalysis; Ultrasound of the liver, gallbladder, pancreas; fibrogastroduodenoscopy (FGDS), duodenal intubation; analysis of feces for lamblia cysts, immunological and allergological examination.

As a result of the study, it was found that in most patients, CSU arose against the background of chronic diseases, including parasitic (intestinal giardiasis) and autoimmune (autoimmune thyroiditis). At the same time, a combination of an increased level of anti-thyroid antibodies and total IgE with a positive ASKP is more often detected with a disease duration of up to 1 year. A high association of the IgE immune response to lamblia with an increased level of total IgE (68.75%) and a negative ASKP (62.5%) was revealed.

Keywords: *CSU, AIT, giardiasis, autogenous skin test, IgE.*

The urgency of the problem

Urticaria is one of the most common forms of allergic skin reactions encountered in the practice of many specialists. In contrast to acute, chronic spontaneous urticaria (CSU) is essentially a syndromic disease, the frequency of which increases annually, and mainly among young people of working age. The clinical manifestation of urticaria is uniform, does not depend on the causes of it, since the central link in the pathogenesis of various variants of the disease is the activation of skin mast cells with the release of histamine and other mediators. However, in most cases of CSU, the mechanisms responsible for this phenomenon are still not known, which makes it difficult to isolate etiological factors and provide adequate therapy.

Various factors act as activators of the mast cell, and in this sense, urticaria can be considered as a polyetiological disease. Among these factors, exogenous ones, including allergens, are well defined. In some cases, when urticaria is associated with infections, the presence of sensitization to the corresponding microorganism is shown, which characterizes the participation of the IgE response to infectious antigens in the activation of mast cells.

Most experts recognize the importance of the relationship between CSU and parasitic invasion. It is believed that this is due to the long-established stimulating role that helminthic invasions play in increasing IgE synthesis and the formation of an IgE-mediated immune response [1]. Nevertheless, not all aspects of this relationship are well studied, and clinical resolution of urticaria by elimination of parasites is achieved only in 8% - 16% of cases [2].

In almost 80% of patients with CSU, it is not possible to identify an exogenous allergen as the cause of the disease; therefore, many researchers come to the conclusion that it is based on an autoimmune process [3,4]. The discovery of the autoimmune nature of the disease in some CSU patients explains the futility of searching for an allergen in the environment.

A number of authors have shown decades ago that in some patients with CSU, the subcutaneous administration of autologous serum caused blistering and hyperemia, that is, a positive local reaction to serum. In 30-50% of CSU patients, functional, histamine-releasing IgG anti $F_c\varepsilon RI$ autoantibodies and IgG anti IgE autoantibodies were found responsible for blistering when autologous serum is injected into the skin. In some patients, a combination of CSU with an autoimmune pathology of the thyroid gland, accompanied by the detection of antithyroid antibodies in the serum, was found [4-6].

In this regard, we set the goal of this study to establish the relationship between several serological parameters of atopy and autoimmunity in CSU.

Patients and methods

The study group consisted of 119 patients with CSU aged 18 to 63 years, selected by way of treatment and registered with the dispensary at the City Allergy Center in Kazan. The basis for the diagnosis was the presence of recurrent blisters in different areas of the skin, persisting for less than 24 hours and appearing at least 2 times a week for at least 6 weeks. The diagnosis of CSU was based on the history and examination of the patients. The majority of patients complained of itchy skin and "volatile" rashes, not associated with any external factor and lasting more than 6 weeks. Examination on various parts of the body revealed characteristic urticarial elements, in some patients accompanied by angioedema on the face, hands and feet.

The comparison group included 10 patients with acute urticaria (AU), who applied to the same center, the duration of the disease was no more than 10 days, 10 patients with autoimmune thyroiditis (AIT) without urticaria, who were hospitalized in the endocrinology department of the 7th City Clinical Hospital of Kazan and 27 healthy volunteers aged 25 to 40, of whom there were 7 men and 20 women.

The material for immunological and allergological studies was blood and serum samples obtained from patients of all groups and healthy individuals in a treatment room in compliance with the rules of asepsis and antiseptics. The serum was separated by centrifugation and stored at –20°C until use. An ex tempore serum was used to perform an autologous serological skin test. Stool samples for analysis for the presence of lamblia cysts were taken from all patients with CC. The analysis was carried out in the clinical laboratory of the Kazan City Clinical Hospital.

Clinical and laboratory examination of patients with CSU included taking anamnesis, examination with characteristics of skin manifestations, assessment of the severity of the disease; general blood test, urine analysis; Ultrasound of the liver, gallbladder, pancreas; fibrogastroduodenoscopy (FGDS), duodenal intubation; analysis of feces for cysts of lamblia.

Autologous serological skin test (ASKP) was performed in all patients with CC according to the method described by Hide M. et al. [7]. At the same time, treatment with antihistamines was stopped at least 48 hours (cetirizine was canceled 4 days) before the skin test.

Venous blood was collected in sterile glass tubes without a clotting catalyst. After the formation of a clot at room temperature after 30 minutes, the serum was separated by centrifugation at 500 g for 15 minutes. Samples of autologous serum, 0.01% histamine solution and 0.9% sterile phosphate buffered saline in a volume of 100 μl were separately injected intradermally into the forearm at a distance of at least 3-5 cm between the injection points. For injections, we selected areas of the skin on which no urticarial manifestations were observed during the last 24 hours.

The results were evaluated according to the method proposed by Sabroe R.A. et al. after 30 and 60 minutes [8]. The area of hyperemia and blister was calculated using the formula π ((d1+d2)/4)2, where d1 and d2 are two perpendicular diameters. The reaction was considered positive in the presence of hyperemia and a blister with an area of at least 9 mm^2.

In the blood serum of the subjects studied by ELISA, the level of total IgE, the content of IgG to TG, TPO and to lamblia was determined using commercial test systems of UAB "NVO Immunotech" (Russia) and JSC "Vector-Best" (Russia). sIgE to lamblia and to TPO in blood serum was also determined by ELISA, using strips with immobilized antigens of lamblia (from the set "Giardia-AT-strip", "Vector-Best") and strips with an immobilized highly purified TPO preparation (link). The detection of sIgE bound to the antigen of lamblia and TPO was carried out using monoclonal antibodies to IgE (8E/4F4) conjugated with horseradish peroxidase (LLC Polygnost, St. Petersburg). The results of the analysis were considered positive when the optical density (OD) of the samples was twice the OD of the negative control. Serum of practically healthy donors (n = 50) was used as a negative control.

Statistical processing of the results included the determination of the reliability of differences in the mean values of quantitative data and the difference in proportions according to the Student's test, as well as the assessment of distribution parameters according to the χ2 criterion.

Results of the study

The group of patients with CSU under our supervision included 27 men (22.7%) and 92 women (77.3%) aged 18 to 67 years. It is noteworthy that almost

half of the respondents - 58 (48.8%) - were women over 30 years old. The duration of the disease with urticaria in the group ranged from 1.5 months. up to 25 years old. In 74 (62.16%) patients, CSU symptoms were observed within 1.5 months - 1 year, in 18 (15.25%) - up to 3 years, the duration of the disease up to 10 years was also noted in 18 (15.65%) patients and only 9 (6.09%) people - the disease lasted more than 10 years. The distribution of patients according to the severity of the disease showed that in most of the patients of the observed group, CSU was mild with the presence of two main symptoms of the disease (characteristic elements of rashes and itching) - 68 (57.2%) people. 40 (33.6%) patients had an average and 11 (9.2%) patients had a severe degree of the disease. Anamnesis data and the results of clinical and laboratory examination made it possible to establish the presence of concomitant chronic diseases in a number of CSU patients. The most common diseases are the diseases of the gastrointestinal tract, less often diseases of the ENT organs and mycotic lesions of the mucous membranes. It is obvious that the majority of patients had a combination of concomitant pathology. In 37 patients with chronic gastrointestinal diseases, including chronic cholecystitis, scatological analysis or examination of the contents obtained by duodenal intubation revealed the presence of lamblia. Thirteen patients were diagnosed with thyroid diseases, which required observation and treatment by an endocrinologist. Allergic history was positive in 7 patients: in 4 patients CSU was accompanied by symptoms of rhinoconjunctivitis of domestic etiology, and in 1 patient from this subgroup urticarial eruptions preceded the onset of asthma attacks; in 1 patient, urticaria occurred upon contact with a cat; in 2 patients, seasonal allergic rhinoconjunctivitis was accompanied by urticaria.

Total IgE values in CSU patients ranged from 25 IU/l to 880 IU/l. An increased level of total IgE was found in 58 (48.7%) patients, while in patients with acute urticaria from the comparison group, an increased level of total IgE was detected in 100% of cases with a range of values from 145 IU/l to 1000 IU/l. When analyzing the relationship between the detection of an increased level of total IgE and the severity of CSU, we were unable to establish significant differences ($p > 0.05$).

During ASKP, a positive reaction was observed in 50 out of 115 CSU patients (43.4%). At the same time, the frequency of detecting positive ASKP did not depend on the severity of CSU and the level of total IgE. At the same time, a connection was established between positive ASKP, as well as its association with an increased level of total IgE with a duration of urticaria for less than 1 year. In patients with a disease duration of less than 1 year (72 people), positive ASKP was found in 38 (52.8%) cases, and in patients with a disease duration of more than 1 year (43 people) - in 12 patients, i.e. in 27.9% of cases ($p = 0.003$). All AIT patients without urticaria (from the comparison group) had negative ASKP results.

To clarify the presence of a relationship between a positive ASKP and one or

another concomitant pathology, we analyzed its distribution in various groups of patients: with gastrointestinal diseases (35 patients), with intestinal giardiasis (32 patients) and with thyroid diseases (13 patients). As the analysis showed, CSU patients with concomitant thyroid diseases tend to more frequently detect a positive reaction to the administration of autoserum than patients with various gastrointestinal diseases (61% and 30%, respectively). In giardiasis of the intestine, the frequency of detecting a positive ASKP is approximately the same as in diseases of the thyroid gland (53%).

In the blood serum of 96 patients, the content of IgG to TG and TPO was determined. The range of IgG to TG values ranged from 3.76 IU/ml to 923.2 IU/ml. An increased content of autoantibodies was detected in 25 patients, the average value of the level in which was 324.2 ± 56.0 IU/ml. In the group of AIT patients, a high level of IgG to TG was noted in half of the patients with an average value of 361.2 ± 91.2 IU/ml. In patients with AU, the content of autoantibodies in only one case exceeded the normal value (144.0 IU/ml). The range of values of the IgG to TPO level in the blood serum of the studied patients ranged from 51.4 IU/ml to 1107.2 IU/ml. An increased content of autoantibodies was detected in 33 (34.4%) patients, the average value was 226.5 IU/ml ± 39.5 IU/ml. In the group of AIT patients, a high level of IgG to TPO was noted in 60% of patients. In 5 patients of this group, the level of autoantibodies exceeded 1000 IU/ml, and in one it was 347.3 IU/ml. In patients with AU, the IgG to TPO content did not exceed normal values, averaging 14.4 IU/ml ± 6.8 IU/ml.

The analysis of the relationship between the detection of an increased content of IgG to TG and TPO with a high level of total IgE and the severity of urticaria did not reveal significant differences. At the same time, it was noted that the combination of an increased level of anti-thyroid autoantibodies and total IgE with a positive ASKP is more often detected with a disease duration of up to 1 year. This suggests the involvement of anti-thyroid autoimmunity in the formation of chronic urticaria syndrome.

Since giardiasis is an endemic parasitosis for the region of residence of patients in the group of this study, to clarify its pathogenetic significance in CSU, we examined the sera of 62 patients with this disease (49 people with concomitant chronic cholecystitis and 13 with other concomitant gastrointestinal diseases) by ELISA for the presence of IgG and IgE antibodies to lamblia with parallel scatological analysis and analysis of the contents of duodenal intubation to detect lamblia.

The presence of IgG to the antigens of lamblia was found in 19 patients with CSU, and IgE in 16 patients. In 30 (61.22%) patients with concomitant chronic cholecystitis, giardiasis was revealed on the basis of scatological analysis and study of duodenal contents. However, not all of these patients had serum containing the corresponding IgG and/or IgE antibodies: immunological confirmation of

analyzes was obtained only in 11 (36.6%) patients. In turn, with negative results of coprological and duodenal analyzes in some patients of both subgroups, an immune response to lamblia antigens was established: in 17 cases out of 32 (53.12%).

Analysis of the relationship between the humoral response to lamblia antigens in CSU patients with atopy and autoimmunity parameters showed that the presence of IgE to lamblia is more associated with negative ASKP and increased total IgE than the presence of IgG antibodies ($p = 0.01$).

Thus, the totality of our studies of various CSU variants allows us to conclude that the activation of the IgE system of the immune system by non-infectious and infectious agents, as well as IgE reactive autoantigens, can be an essential link in the pathogenesis of CSU, the duration and severity of the course of which (actually chronization) is determined by the constant nature of stimulation with chronic infection and autoimmune pathology.

References

1. Giardia duodenalis and its involvement in skin diseases. Humbert P, Guichard A, Bennani I, Chiheb S.Ann Dermatol Venereol. 2017;144(11):676-684. doi: 10.1016/j.annder.2017.08.002.

2. Chernikova E.A., Drynov G.I. Helminthiasis in the practice of an allergist. Asthma and allergies. 2016; 1: 27-32.

3. Confino-Cohen R, Chodick G, Shalev V, Leshno M, Kimhi O, Goldberg A. Chronic urticaria and autoimmunity: associations found in a large population study. J Allergy Clin Immunol. 2012; 129: 1307–1313.

4. Najafipour M, Zareizadeh M, Najafipour F. Relationship between Chronic urticaria and autoimmune thyroid disease.J Adv Pharm Technol Res. 2018; 9(4): 158-161. doi: 10.4103 / japtr.JAPTR_342_18.

5. Najib U, Bajwa ZH, Ostro MG, Sheikh J. A retrospective review of clinical presentation, thyroid autoimmunity, laboratory characteristics, and therapies used in patients with chronic idiopathic urticaria. Ann Allergy Asthma Immunol. 2009; 103:496–501.

6. Kaplan AP. Diagnosis, pathogenesis, and treatment of chronic spontaneous urticaria. Allergy Asthma Proc. 2018 May 1;39(3):184-190. doi: 10.2500/aap.2018.39.4121.

7. Hide M., Francis D.M., Grattan C.E.H., Hakimi J., Kochan I.P., Greaves M.W. – Autoantibodies against the high-affinity IgE receptor as a cause of histamine release in chronic urticaria // The New England Journal of Medicine – 1993 – June 3 – v. 1599-1604.

8. Konstantinou G. N., Asero R., Maurer M., Sabroe R. A., Schmid-Grendelmeier P., Grattan C. E. H. EAACI/GA2 LEN task force consensus report: the autologous serum skin test in urticaria. Allergy 2009; 64: 1256–1268.

DOI 10.34660/INF.2020.39.63.017

研究基于2-苯基-9-二乙基氨基乙基咪唑并[1,2-A]苯并咪唑的硝酸硝酸盐的片剂剂型对兔的慢性毒性作用

TO STUDY THE CARDIOTOXIC EFFECT OF A TABLET DOSAGE FORM BASED ON 2-PHENYL-9-DIETHYLAMINOETHYLIMIDAZO[1,2-A]BENZIMIDAZOLE DINITRATE IN RABBITS UNDER CONDITIONS OF CHRONIC TOXICITY

Domanina Angelina Mikhailovna
Postgraduate
Chernikov Maxim Valentinovich
Doctor of Medical Sciences, Associate Professor
Pyatigorsk Medical and Pharmaceutical Institute
Volgograd State Medical University

抽象。 本文讨论了研究新合成的基于2-苯基-9-二乙基氨基乙基咪唑[1,2-A]苯并咪唑二硝酸盐的FDF的抗溃疡和抗分泌作用对实验兔心脏活性参数的慢性毒性作用的结果。 研究。 由于在现代世界中，与心血管系统有关的疾病的患病率很高，并且使死亡的人难以控制，因此实际的解决方案是确定这种FDF在慢性毒性条件下对心肌功能的影响。 为了排除片剂剂型对心脏功能的负面影响。

关键词：慢性毒性，心脏毒性，心电图。

Abstract. *This article discusses the results of studying the effect of newly synthesized FDF based on 2-phenyl-9-diethylaminoethylimidazo [1,2-A] benzimidazole dinitrate with antiulcer and antisecretory effects on the parameters of the cardiac activity of laboratory rabbits in a chronic toxicity study. Since in the modern world diseases associated with the cardiovascular system have a very high prevalence and hold the sad palm in the structure of mortality, the actual solution was to identify the effect of this FDF on the work of the heart muscle in conditions of chronic toxicity in order to exclude the negative effect of the tablet dosage form for the functioning of the heart.*

Keywords: *chronic toxicity, cardiotoxicity, electrocardiogram.*

Purpose of the study: investigate the cardiotoxic effect of a tablet dosage form based on 2-phenyl-9-diethylaminoethylimidazo [1,2-A] benzimidazole dini-

trate in rabbits under conditions of chronic toxicity.

Introduction

It is known that many drugs have a negative effect on organs and systems, and thus, an urgent task of experimental pharmacology is to minimize the negative effects of drugs. Chronic toxicity is one of the main parameters for assessing the safety of a medicinal product. It depends on the structure of the dosage form, structure, the ability to form strong bonds with plasma proteins and the use of the drug in combination therapy. FDF based on 2-phenyl-9-diethylaminoethylimidazo [1,2-A] benzimidazole dinitrate has antiulcer and antisecretory activity. According to statistical data, the risk group for gastric ulcer is middle-aged and retirement age, and these persons often have disorders of the cardiovascular system. Therefore, the study of the work of the heart in conditions of chronic toxicity is relevant.

Materials and methods

To study the work of the heart in conditions of chronic toxicity, FDF based on dinitrate 2-phenyl-9-diethylaminoethylimidazo [1,2-A] benzimidazole, the analysis was carried out on male and female rabbits of the Soviet Chinchilla breed weighing 2000-2500 g (age 10 -12 weeks) at the start of the study. The number of animals used is sufficient for a full assessment and interpretation of the considered action and complies with the recommendations set out in the Guidelines for conducting preclinical studies of drugs [1]. According to the guidelines for the study of the general toxic effect of pharmacological agents [2], the chronic toxicity of FDF based on 2-phenyl-9-diethylaminoethylimidazo [1,2-A] benzimidazole dinitrate was studied in 3 doses, since the test compound is original and for it planned oral administration in a clinical setting. When studying the work of the heart in conditions of chronic toxicity of FDF in rabbits, doses of 5 mg/kg, 25 mg/kg, and 50 mg/kg were used, calculated using interspecies conversion factors (P). Duration of application is 180 days, daily. The route of administration is intragastric, using an atraumatic probe. The limiting volume of the finished suspension based on purified water poured into rabbits did not exceed 100 ml. For further analysis (180 days), 16 groups of animals were formed. After dividing the male and female rabbits into their respective groups, it was assumed that Group 1 (male rabbits) and Group 2 (female rabbits) would be the standards without the introduction of the FDF suspension. Group 3 male rabbits and group 4 female rabbits were intragastrically injected with dissolved tablets at a dose of 5 mg/kg. Also, the corresponding groups of male rabbits (5 and 7) and female rabbits (6 and 8) were injected with a dosed suspension at dosages of 25 mg/ml and 50 mg/ml, respectively. This study was carried out for 180 days, the dosage suspension administered was recorded daily. Further, according to the study model, on the 90th day and on the 180th day, the work of the heart muscle of the groups of male and female rabbits was measured under conditions of chronic toxicity. Registration of electrocardio-

grams in rabbits was carried out under anesthesia in order to eliminate inaccuracies caused by tremors and individual twitching of the muscles. In the study of the bioelectrical activity of the heart, a Poly-Spect-8/V electrocardiograph was used. Parameters such as the amplitude of the teeth (P, R, T) and the duration of the intervals (P-Q, QRS, Q-T, R-R) in standard lead II were recorded, and such a parameter as the heart rate was also taken into account. After that, the analyzed values were entered into tables for further data processing.

To calculate the reliability of the result, the following formula was used, where the following value was taken into account: this is the difference between the two analyzed values and the difference between the values of the control samples.

$$P = \frac{\text{Хисп}_2}{\text{Хк}_2} - \frac{\text{Хисп}_1}{\text{Хк}_1}$$

Where,

P- confidence factor;

Хисп_2 - the value of the investigated parameter;

Хисп_1 - the value of the investigated parameter relative to the first;

$\text{Хк}_{1,2}$ - the value of control samples 1 and 2.

Results and discussion

Based on the results of the study, it was found that in the studied groups of animals the parameters of the electrocardiograms did not exceed the values of the standard groups, as evidenced by the coefficient of reliability relative to the control ($P < 0.05$). The introduction of a higher dosage also did not affect the set parameters of the electrocardiogram. Also studied was the heart rate, which shows the interval of contraction of the heart muscle. According to the data obtained, the deviation from the standard parameters is not significant, therefore, it can be judged that the analyzed tablet dosage form does not have a negative effect. The anesthetic agent that was administered to male rabbits and female rabbits also did not affect the studied parameters of the electrocardiogram and did not distort the data obtained in comparison with control groups 1 and 2.

The registered results of the study of the bioelectric activity of the heart muscle are presented in summary tables 1-2.

Table 1 - *Parameters of electrocardiograms in male rabbits (groups 1,3,5,7) and female rabbits (groups 2,4,6,8) after administration of an FDF suspension based on 2-phenyl-9-diethylaminoethylimidazo dinitrate [1, 2-A] benzimidazole for 90 days (M±m) N = 4*

ECG parameters	Study groups, (dose)							
	Control Group 1	Control Group 2	FDF 5 mg/kg Group 3	FDF 5 mg/kg Group 4	FDF 25 mg/kg Group 5	FDF 25 mg/kg Group 6	FDF 50 mg/kg Group 7	FDF 50 mg/kg Group 8
P wave amplitude (mV)	0,035±	0,045±	0,045±	0,043±	0,035±	0,038±	0,035±	0,038±
	0,0050	0,0132	0,0050	0,0048	0,0065	0,0075	0,0065	0,0103
R wave amplitude (mV)	0,268±	0,263±	0,185±	0,170±	0,118±	0,255±	0,193±	0,188±
	0,029	0,041	0,019	0,020	0,041*	0,049	0,015	0,024
T wave amplitude (mV)	0,050±	0,043±	0,055±	0,058±	0,043±	0,058±	0,040±	0,033±
	0,012	0,005	0,010	0,015	0,008	0,013	0,009	0,013
P-Q interval (ms)	55,250±	62,750±	56,250±	59,500±	54,750±	57,500±	55,000±	53,000±
	2,056	1,601	1,315	3,069	5,170	3,227	2,273	3,000*
QRS interval (ms)	40,500±	38,000±	49,500±	42,500±	35,500±	37,750±	40,750±	43,250±
	0,500	4,899	4,924	6,292	6,076	1,315	1,887	1,493
Q-T interval (ms)	143,500±	120,500±	137,000±	141,000±	125,500±	189,000±	165,500±	144,750±
	5,041	8,451	8,534	6,940	5,737	15,588*	12,400	17,250
R-R interval (ms)	192,250±	185,750±	181,000±	198,250±	167,750±	209,000	187,000±	193,000±
	16,023	13,592	4,761	12,099	9,733	15,100	1,080	9,390
HR	314,500±	324,500±	332,000±	305,500±	362,500±	291,500	320,750±	313,000±
	28,944	21,643	8,822	16,835	20,835	21,136	1,797	14,160

Note: * - reliability relative to control P <0.05

Further, according to the study model, the following ECG parameters were assessed: the amplitudes of the P, R, T waves, the P-Q, QPS, Q-T, R-R intervals and the heart rate (HR) for 180 days.

Table 2 - *Parameters of electrocardiograms in male rabbits (groups 1,3,5,7) and female rabbits (groups 2,4,6,8) after administration of an FDF suspension based on 2-phenyl-9-diethylaminoethylimidazo dinitrate [1, 2-A] benzimidazole for 180 days (M ± m) N = 4*

ECG parameters	Study groups, (dose)							
	Control Group 1	Control Group 2	FDF 5 mg/kg Group 3	FDF 5 mg/kg Group 4	FDF 25 mg/kg Group 5	FDF 25 mg/kg Group 6	FDF 50 mg/kg Group 7	FDF 50 mg/kg Group 8
P wave amplitude (mV)	0,040±	0,040±	0,050±	0,045±	0,050±	0,045±	0,055±	0,050±
	0,0071	0,0071	0,0108	0,0065	0,0071	0,0065	0,0119	0,0041
R wave amplitude (mV)	0,193±	0,180±	0,190±	0,175±	0,165±	0,180±	0,170±	0,195±
	0,015	0,011	0,021	0,024	0,022	0,013	0,039	0,021
T wave amplitude (mV)	0,028±	0,028±	0,053±	0,040±	0,028±	0,038±	0,045±	0,020±
	0,009	0,009	0,013	0,009	0,005	0,008	0,016	0,004
P-Q interval (ms)	52,250±	59,750±	52,000±	54,250±	53,500±	53,750±	60,500±	60,750±
	2,594	5,721	2,708	4,049	5,605	2,394	10,444	4,151
QRS interval (ms)	36,750±	42,250±	39,250±	41,000±	40,000±	30,250±	49,250±	43,000±
	3,902	7,064	2,462	6,258	5,148	2,250	9,196	1,225
Q-T interval (ms)	133,250±	129,750±	132,000±	133,750±	129,500±	179,750±	139,750±	117,750±
	12,499	14,401	15,094	26,244	4,699	19,276	16,904	3,172
R-R interval (ms)	181,000±	190,750±	208,750±	165,000±	216,250±	203,250±	197,500±	203,750±
	9,183	4,715	11,434	7,405*	7,330	10,266	8,665	6,343
HR	334,000±	293,750±	290,250±	365,250±	278,250±	296,750±	305,500±	296,500±
	17,800	14,619	17,423	15,288*	9,911	13,865	13,124	10,380

Note: * - reliability relative to control P <0.05.

Conclusions

The ECG study showed that the calculated values of the parameters of the teeth and ECG intervals of male rabbits of the groups 3,5,7 and female rabbits of the 4,6,8 groups did not differ from the control samples. There were single significant deviations that were within the physiological norm and did not have a systemic dose-dependent nature and cannot be interpreted as a result of the formation of the cardiotoxic effect of FDF based on 2-phenyl-9-diethylaminoethylimidazo [1,2-A] benzimidazole dinitrate. The rhythm was sinus, extrasystoles, bigymeni, trigyme-

ny and other pathological ECG changes were not recorded. Therefore, this tableted dosage form does not have a negative effect on the work of the heart muscle under conditions of chronic toxicity. These studies will be taken into account when registering the studied tablets based on 2-phenyl-9-diethylaminoethylimidazo [1,2-A] benzimidazole dinitrate.

References

1. Mironov A.N. Guidelines for conducting preclinical studies of drugs.-2012.-P.12-13

2. E.V. Arzamastsev, T.A. Guskova, S.S. Lieberman, B.I.Lyubimov, A.G. Rudakov, O.L. Verstakova. Methodical recommendations for the study of the general toxic effect of pharmacological agents.-1997

3. Spasov A.A., Petrov V.I., Anisimova V.A., Minkin V.I., Chernikov M.V. Medicinal substance for suppressing helicobacter-like erosive and ulcerative lesions of the gastric mucosa // Patent RU 2395282, 2010.

4. Zhang Heibing, Zhou Jinpei, Li Qing, Zong Yan, Xing Xinghao, Zhao Leili, Zhou Mu Xing, Wang Yining, Benzimidazole derivative, method for its preparation and its medicinal use // Patent CN 103896915 A, 2014.

5. Anisimova V.A., Spasov A.A., Tolpygin I.E., Minkin V.I., Chernikov M.V., Yakovlev D.S., Stukovina A.Yu., Goryagin I.I., Grechko O.Yu., Kirillova N.V., Kosolapov V.A., Tibirkova E.V., Salaznikova O.A., Naumenko L.V., Gurova N.A. Synthesis and pharmacological activity of 9-R-2-halophenylimidazo [1,2-a] benzimidazoles // Pharmaceutical Chemistry Journal. – 2010. - V. 44. - №7. – P.7-13.

6. Belousova E.A., Loginov A.F. Possibilities of H2-histamine receptor blockers in modern gastroenterology // Consilium Medicum. – 2003. – V. 5. – № 10.

DOI 10.34660/INF.2020.20.50.018

咪唑并[1,2-a]苯并咪唑-9-（2-二乙基氨基乙基）-2-苯基咪唑并[1,2-a]苯并咪唑二硝酸盐的光谱分析方法

METHODS OF SPECTROSCOPIC ANALYSIS OF IMIDAZO [1,2-A] BENZIMIDAZOLE - 9- (2-DIETHYLAMINOETHYL) -2-PHENYLIMIDAZO [1,2-A] BENZIMIDAZOLE DINITRATE

Mitrakova Darya Olegovna
Postgraduate
Pyatigorsk Medical and Pharmaceutical Institute

Remezova Irina Petrovna
Doctor of Pharmaceutical Sciences, Full Professor
Pyatigorsk Medical and Pharmaceutical Institute

Morozov Andrey Vladimirovich
Candidate of Pharmaceutical Sciences, Senior Lecturer
Pyatigorsk Medical and Pharmaceutical Institute

Volgograd State Medical University
Pyatigorsk, Russia

抽象。基于咪唑并[1,2-a]苯并咪唑的生物活性化合物是由位于顿河畔罗斯托夫的物理和有机化学科学研究所FSAEI HE“ Southern Federal University”合成的。该物质通过阻断H2-组胺受体来减少盐酸的分泌，这是其胃保护作用的原因。该研究的目的是开发用于通过分光光度法鉴定和控制RU-64物质的方法。材料和方法。该研究的目的是化合物9-（2-二乙基氨基乙基）-2-苯基咪唑并[1,2-a]苯并咪唑二硝酸盐。根据该物质的理化性质，提出了其分析方法：NMR，IR，UV分光光度法。作为研究的结果，研究了光谱特性并开发了定性分析方法。结论。可以提出已开发的定性分析方法以进一步研究该物质。

关键词：咪唑并[1,2-a]苯并咪唑衍生物；抗分泌活性；质量控制； NMR分光光度法； IR分光光度法；紫外分光光度法

Abstract. *A biologically active compound based on imidazo [1,2-a] benzimidazole was synthesized at the Scientific Research Institute of Physical and Organic Chemistry FSAEI HE "Southern Federal University" in Rostov-on-Don. The substance reduces the secretion of hydrochloric acid by blocking the H2-histamine receptors, which is responsible for its gastroprotective effect.*

The purpose *of the study is the development of methods for identification and quality control of the RU-64 substance by spectrophotometric methods.*

Materials and methods. *The object of this study is the compound 9- (2-diethylaminoethyl) -2-phenylimidazo [1,2-a] benzimidazole dinitrate. Based on the physicochemical properties of the substance, methods of its analysis are proposed: NMR, IR, UV spectrophotometry. As a result of the studies, spectral characteristics were studied and methods of qualitative analysis were developed.*

Conclusion. *The developed methods of qualitative analysis can be proposed for further studies of the substance.*

Keywords: *imidazo [1,2-a] benzimidazole derivative, antisecretory activity, quality control, NMR spectrophotometry, IR spectrophotometry, UV spectrophotometry*

Diseases of the gastrointestinal tract are among the most common pathologies in the world. Of these, the leading place is occupied by gastropathies associated with erosive and ulcerative damage to the mucous membrane [1]. Many endogenous and exogenous factors are involved in the pathogenesis of these lesions, but one of the main ones is the increased secretion of hydrochloric acid. For this reason, the search for new drugs exhibiting antisecretory activity is becoming more and more urgent. To solve this problem, a biologically active compound was synthesized at the Scientific Research Institute of Physical and Organic Chemistry FSAEI HE "Southern Federal University" (Rostov-on-Don) - a derivative of imidazo [1,2-a] benzimidazole: dinitrate 9- (2-diethylaminoethyl) -2-phenylimidazo [1,2-a] benzimidazole (laboratory code RU-64). It was found that the substance exhibits antisecretory activity by blocking the H2-histamine receptors. Therefore, it was proposed to use this substance to expand the range of drugs for pharmacological correction of gastric ulcer and duodenal ulcer [2].

Spectral methods of analysis are of great importance in the study of the chemical structure and composition of complex chemical compounds. They are characterized by fast execution, high efficiency and accuracy of analysis even with small amounts of the analyte (mg and μg).

The aim of this study is to study the spectral properties of the substance dinitrate 9- (2-diethylaminoethyl) -2-phenylimidazo [1,2-a] benzimidazole and the development of methods for its identification using spectroscopic methods of analysis: NMR-, IR- and UV-spectroscopy.

The studies were carried out on the substance 9- (2-diethylaminoethyl) -2-phenylimidazo [1,2-a] benzimidazole dinitrate. Laboratory code RU-64. Chemical formula: C21H24N4*2HNO3. Molecular weight: 458.47.

The analysis of the substance by the NMR spectroscopy method was carried out on the basis of the Scientific Research Institute of Physical and Organic Chem-

istry FSAEI HE "Federal State University" in Rostov-on-Don. NMR analysis was performed on an NMR Bruker Avance 600 spectrometer (600 MHz) (manufactured by Bruker, Germany). The position of the signals in the NMR spectrum can be used to judge the structure of the molecule, since the protons of certain groups of atoms give their characteristic chemical shifts in a certain region of the spectrum [5]. In the 1H NMR spectra of RU-64, recorded in DMSO-d6, the following chemical shifts were recorded, δ ppm: 3,39(m,4H,CH2-N-CH2-); 3,82(t,2H, CH2-NEt2); 4,79 (t, 2H, N(9)-CH2); 7,44(m,2H, ArH); 7,49(t,1H, ArH); 7,95(dd, 1H, ArH); 7,99(dd, 1H,ArH); 8,01(dd, 1H,ArH); 8,49(s, 1H, 3-H) (fig. 1)

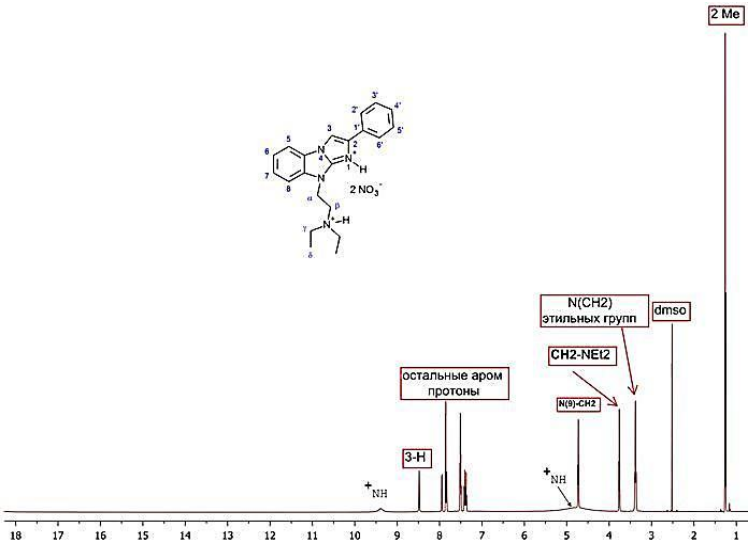


Figure 1 - *NMR spectrum of RU-64 substance in DMSO-d6*

The obtained NMR spectrum can be used for functional analysis and confirmation of the structure of the test substance.

IR spectrophotometry was carried out on an FSM-1201 IR-Fourier spectrometer in the wavelength range from 400 to 7800 cm-1, "Infrospek" LLC, St. Petersburg, Russia according to the scheme of pressed discs. 3 mg of the substance powder was combined with 200 mg of potassium bromide powder, which was previously thoroughly crushed to particles less than 2 μm (about 1 μm) and dried in vacuum at 105°C for 12 h [6]. The mixture is also thoroughly ground. Then the resulting homogeneous mixture is placed in a mold and leveled with a spatula. The pressing was carried out at a pressure of about 800 MPa (8 t/cm^2) for 5 min-

utes in a vacuum (3 mmHg). The resulting disk, 13 mm in diameter, was placed in a preheated IR-Fourier spectrophotometer (switched on 30-40 minutes before analysis). The IR spectrum was recorded in the radiation range from 4000 to 400 cm – 1 [4].

The IR spectrometry method consists in recording the transitions between the energy levels of molecules in the IR range. The signal intensity, the position of the maxima, and their width depend on many characteristics of an individual molecule. Therefore, IR spectra are highly specific and can be used to determine the authenticity and good quality of RU-64. When analyzing the RU-64 substance, a spectrum was obtained with the following characteristic bands (cm-1): 1610, 1600, 1508, which correspond to stretching vibrations of the C = C bond in the aromatic ring, 1670 - the C = N bond in the cycle, 2400-2600 - belongs to (R)3NH + (fig. 2).

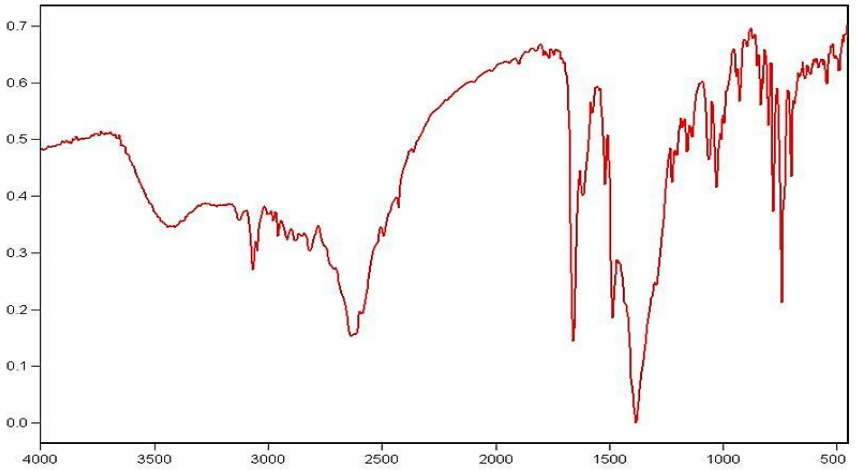


Figure 2 - *IR spectrum of a substance in the wavelength range from 400 to 7800 cm-1*

The bands in the IR spectrum correspond to specific functional groups in the structure of the molecule. The characteristic absorption bands in the obtained IR spectrum can be used to judge the structural features of the organic molecule, since the absorption bands are constant and specific for certain groups of atoms and do not depend on the structure of the rest of the molecule. There are tables of characteristic frequencies by which the structure of the molecule can be assumed. The identity of the substance is confirmed by the complete coincidence of the IR spectra of the analyte with the IR spectra of the standard sample.

The UV spectrum of the substance was recorded on an SF-2000 spectrophotometer with an operating wavelength range of 200 to 750 nm, JSC "OKB Spektr", St. Petersburg, Russia.

When choosing the optimal solvent for the preparation of the analyzed solution, both the solubility of the substance and the toxicity of the solvents were the basis, since the technique is supposed to be used for in-line analyzes. Purified water is most suitable. The UV absorption spectrum of an aqueous solution prepared at a concentration of 0.0008% was recorded in the near ultraviolet wavelength range (from 200 to 350 nm) in cuvettes with a working layer length of 10 mm [5].

The UV spectrum of a substance is the dependence of the absorption intensity on the wavelength, expressed as a graph. The absorption of light depends on the electronic structure of the substance. UV spectrophotometry is used not only for qualitative but also for quantitative analysis. The UV spectrum of RU-64 substance is shown in fig. 3.

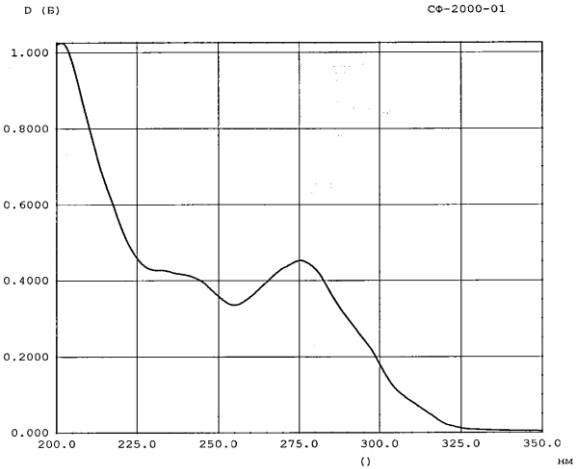


Figure 3 - *UV spectrum of an aqueous solution of RU-64 substance in the wavelength range from 200 to 350 nm*

The obtained UV spectrum indicates that in the region from 200 to 350 nm there is a maximum at a wavelength of 275 nm and a minimum at 255 nm. Authenticity is confirmed by the coincidence of the spectrum of the analyzed substance with the spectrum of the standard sample.

Based on the study of the spectral properties of a new biologically active compound, 9- (2-diethylaminoethyl)-2-phenylimidazo [1,2-a] benzimidazole dinitrate,

substance RU-64, it is proposed to identify it by NMR spectroscopy, IR spectrometry and UV spectrophotometry.

References

1. Ivashkin V.T., Sheptulin A.A., Maev I.V., Baranskaya E.K., Trukhmanov A.S., Lapina T.L., Burkov S.G., Kalinin A.V., Tkachev A.V. Clinical guidelines of the Russian Gastroenterological Association for the diagnosis and treatment of peptic ulcer // Ross. Journ. Gastroenterol., hepatol., coloproctol.- 2016. - V. 26. - № 6. - P. 40-54.

2. Patent for invention 2008136173/15 Russ. Federation. № 2395282. A medicinal substance for the suppression of heliuobacter-like erosive and ulcerative lesions of the gastric mucosa. Appl. 09.09.2008; publ. 27.07.2010.

3. Federal electronic medical library [Electronic resource]. – M.: MHRF. - 2015 -. - Access: http://www.femb.ru/feml, public. – Screenshot

4. Kolesnik I.V. Infrared spectroscopy / I.V. Kolesnik., N.A. Sapoletova – M.: M.V. Lomonosov MSU, - 2011. – 88 P.

5. State Pharmacopoeia of the RF. – XII ed. – M.: Scientific center for expertise of medicinal products, 2008. – Part 1. – 704 P.

6. Silverstein R., Bassler G., Morril T. Spectrometric identification of organic compounds. M.: World, 1977. – 590 P.

DOI 10.34660/INF.2020.59.37.019

含硼生物活性玻璃: 制备和性能
BORON-CONTAINING BIOACTIVE GLASSES: PREPARATION AND PROPERTIES

Grishchenko Dina Nikolaevna
Candidate of Chemical Sciences, Research Officer
Medkov Mihail Azarievich
Doctor of Chemical Sciences, Full Professor, Head of Laboratory.
Institute of Chemistry,
Far Eastern Branch of the Russian Academy of Sciences

抽象。 通过有机溶液的热解获得了掺硼生物活性玻璃。 已经证明获得含有1至60重量％的B 2 0 3的生物玻璃的可能性。 通过在生物玻璃“ 45S5生物玻璃”的组成中用B 2 0 3代替一部分Si0 2来获得含硼生物活性玻璃。 在有机溶剂中使用四乙氧基硅烷，磷酸三丁酯，油酸钠和油酸钙获得生物玻璃。 通过液固相萃取获得高浓度的有机硼溶液用于掺杂生物玻璃。 对获得的生物玻璃的抗菌性能进行评估。 所提出的方法使得有可能获得粉末材料形式和各种多孔载体上的涂层形式的生物活性玻璃。 这允许在现代医学的骨植入术领域中使用发展。

关键词：生物玻璃，含硼生物材料，生物活性涂层，有机溶液的热解。

Abstract. *Boron-doped bioactive glasses were obtained by pyrolysis of organic solutions. The possibility of obtaining bioglass containing B_2O_3 from 1 to 60 wt% has been demonstrated. Boron-containing bioactive glass was obtained by replacing part of SiO_2 with B_2O_3 in the composition of bioglass "45S5 Bioglass". Tetraethoxysilane, tributyl phosphate, sodium oleate and calcium oleate in an organic solvent were used to obtain bioglass. A highly concentrated organic boron solution was obtained by liquid-solid-phase extraction for doping bioglass. An assessment of the antibacterial properties of the obtained bioglass was carried out. The proposed method makes it possible to obtain bioactive glasses both in the form of powder materials and in the form of coatings on various porous carriers. This allows the use of developments in the field of bone implantology in modern medicine.*

Keywords: *bioglass, boron-containing biomaterials, bioactive coatings, pyrolysis of organic solutions.*

The medical need for materials used to replace or regenerate bone tissue serves as a stimulus for the development of various biomaterials, including bioactive glasses [1,2]. Bioglass is very promising for bone tissue engineering due to their ability to precipitate hydroxyapatite upon contact with physiological body fluid. It is he, hydroxyapatite, that provides a strong bond between artificial material and bone and soft tissues [3]. The research is based on the discovery of L. Hench and his collaborators of bioglass "45S5 Bioglass". They proved that the composition possesses the properties of a biocompatible, bioactive, biodegradable, osteoconductive and osteoinductive material [4].

Boron-doped bioactive glasses are currently of interest due to their enhanced biological activity, improved biocompatibility, and antibacterial properties [5, 6]. Boron can affect vital processes, including bone growth. Boron-containing bioglass causes an increased proliferation of osteoblasts in cells [7], and controlled release of boron from bioglass can promote improved bone tissue regeneration [8].

The purpose of this work is to study the preparation conditions, as well as some characteristics and properties of boron-containing bioactive glasses.

To obtain bioglass, we used solutions containing sodium oleate and calcium oleate in turpentine, tetraethoxysilane, tributyl phosphate. Boric acid was dissolved at 180°C in a mixture of tri-n-octylamine and octyl alcohol, with a ratio of 1: 1. An organic solution containing boron in specified proportions was mixed with a solution containing the rest of the glass components, and the solvent was distilled off at a temperature of 150–200°C. The resulting mass (precursor) was subjected to pyrolysis by heating in a muffle furnace to 1300°C.

The study of antibacterial activity consisted in assessing the degree of growth of the bacterial film of *Pseudomonas aeruginosa* on the surface of bioglass samples with a content of 0.5, 15 wt.% B_2O_3. The samples were placed in a liquid nutrient medium with a bacterial culture. The cultivation was carried out at 37°C for 48 hours.

To obtain bioglass, we have proposed a method of pyrolysis of organic solutions [9]. A number of advantages of obtaining bioglass by this method are noted. The method allows doping components to be introduced into glass. They can be introduced in organic solvents in the form of extracts [10]. To obtain boron-containing bioglass, the method of liquid extraction is not applicable, since boron is poorly extracted from aqueous solutions. In this regard, we have developed a method for liquid-solid-phase extraction of boron: boric acid was dissolved in a mixture of tri-n-octylamine and octyl alcohol by heating. The method of liquid-solid-phase extraction allows to obtain a highly concentrated organic boron solution: up to 40 wt% H_3BO_3 in a mixture of solutions. The proposed method makes it possible to vary the boron content in the samples in a wide range and to obtain glasses or glass ceramics of various compositions.

X-ray phase analysis data (fig. 1) show that pyrolysis of the precursor after distilling off the solvent at a firing temperature of up to 700°C leads to the formation of a mixture of an X-ray amorphous phase with crystalline $Na_4Ca_4(Si_6O_{18})$. At temperatures of 700–1000°C, crystalline phases of $Na_4Ca_4(Si_6O_{18})$, Ca_2SiO_4, Na_2CaSiO_4 are formed. At 1300°C, the sample becomes X-ray amorphous.

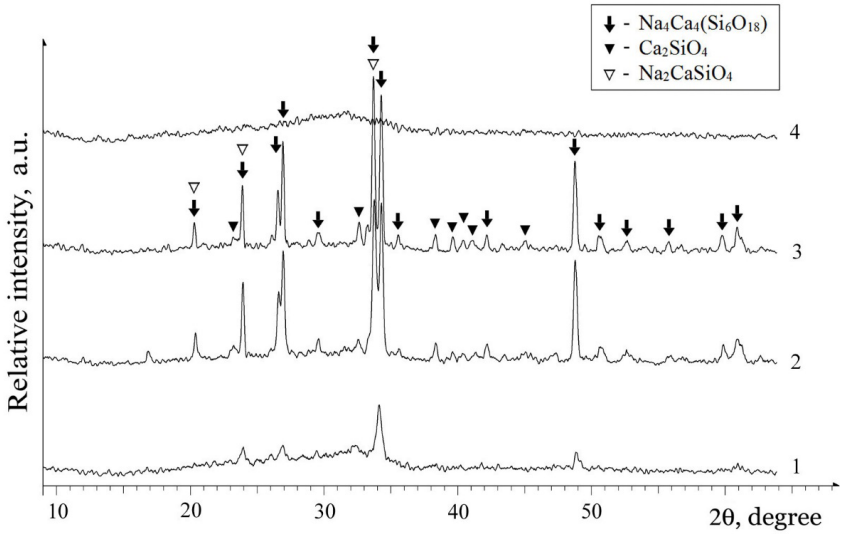


Fig. 1. *Diffraction patterns of a bioglass sample without B_2O_3, at a firing temperature of:1 – 500°C, 2 – 700°C, 3 – 1000°C, 4 – 1300°C.*

Glasses containing 1 - 25% boron oxide are transparent (fig. 2, a), X-ray amorphous and contain all components: silicon, oxygen, sodium, calcium, phosphorus, and boron. In the energy dispersive spectrum, boron gives a very weak signal; therefore, it practically merges with the background signal (fig. 2b).

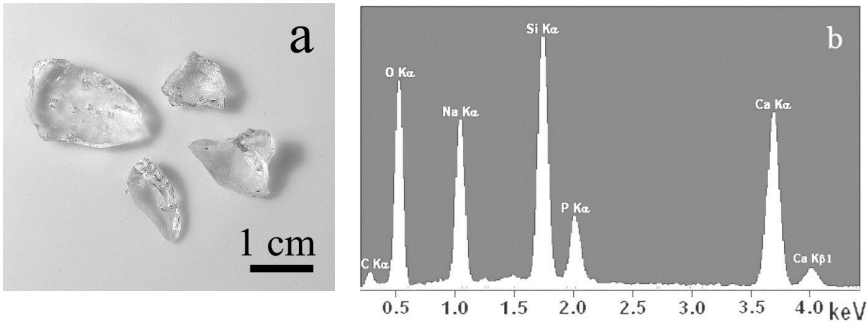


Fig. 2. *Photo (a) and energy dispersive spectrum (b) of bioglass containing 15 wt% B_2O_3.*

Diffraction patterns of samples 1 - 25% B_2O_3 in the temperature range 500 - 1000°C, in addition to X-ray amorphous, show the presence of two phases Ca_2SiO_4, $Na_4Ca_4(Si_6O_{18})$. With an increase in boron content, calcium phosphate phases appear in the samples, this is probably due to the displacement of the phosphate anion from the silicate glass network (fig. 3).

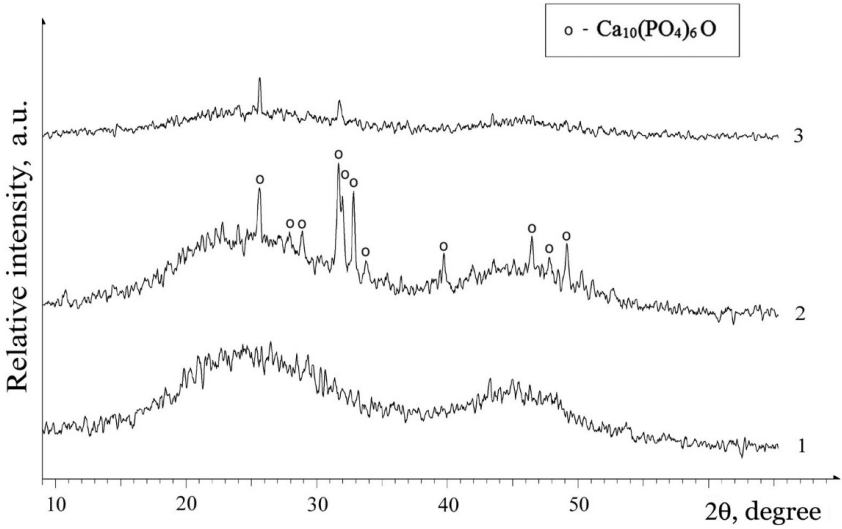


Fig. 3. *Diffraction patterns of a bioglass sample containing 60 wt% B_2O_3 at the firing temperature of: 1 – 500ºC, 2 – 1000ºC, 3 – 1300ºC.*

Research shows that when samples are fired up to 700°C, a hydroxyapatite phase is formed. When the firing temperature rises to 1000°C and higher, the oxyapatite phase is formed. Subsequently, when interacting with the environment of the body, oxyapatite is again converted into hydroxyapatite. Hydroxyapatite is known to be the main mineral component of bone tissue, it is actively synthesized and studied by scientists as a biomaterial [11].

The antimicrobial activity of boron-containing glasses was studied using the example of a multi-resistant bacterial strain *Pseudomonas aeruginosa*. It was noticed that the composition of the sample influences the formation of the bacterial biofilm. Scanning microscopy data indicate a significant decrease in biomass and a decrease in the total cell volume in *P. aeruginosa* biofilms with an increase in the percentage of B_2O_3 in the samples (fig. 4). It can be concluded that B_2O_3 in bioglass has antibacterial and antibiofilm properties. B_2O_3 can be considered as an effective component of bioactive glasses for the prevention and treatment of biofilm-related infections of bone and joint prostheses.

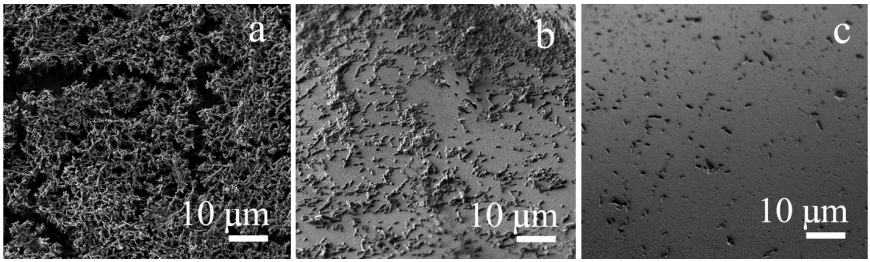


Figure: 4. *Antimicrobial activity of boron-containing bioglass: 0 wt% B_2O_3 (a), 5 wt% B_2O_3 (b), 15 wt% B_2O_3 (c).*

It is known that the mechanical properties of bioglass are inferior to bone tissue. When creating implants that replace bone tissue, the formation of bioactive glass-ceramic coatings on carriers made of more durable materials is used. The most convenient method of forming coatings is the impregnation of carriers with an organic solution containing all the components of bioactive glass, and their subsequent firing. The method allows the formation of durable bioactive coatings on bioinert substrates. Such a bioactive layer should facilitate an anatomical relationship between the bone tissue and the implant surface. Fig. 5 and 6 show photomicrographs and energy dispersive spectra of the initial ceramics of γ-Al_2O_3 and ceramics coated with bioglass containing 15 wt% B_2O_3. It can be seen from the above figures that the surface morphology of the ceramics practically did not change. Lines of glass components appeared in the energy dispersive spectrum, and the intensity of the aluminum signal decreased significantly.

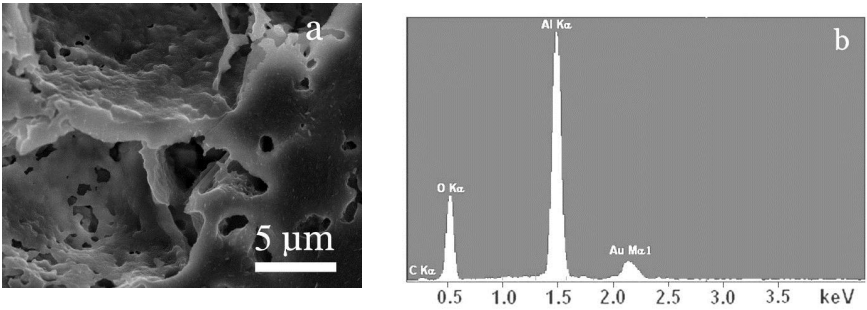


Fig. 5. *Micrograph (a) and energy dispersive spectrum (b) of the γ-Al_2O_3 sample.*

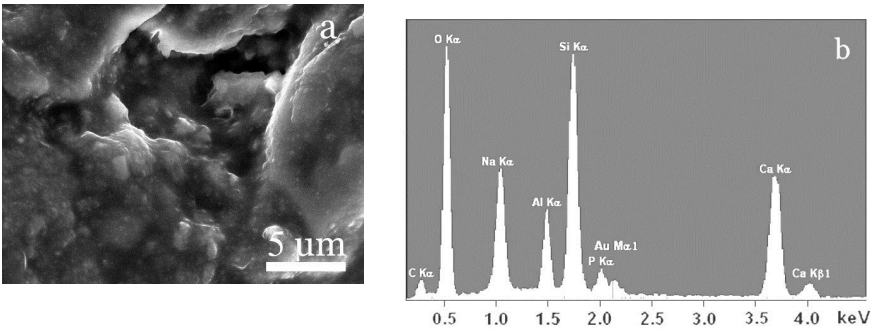


Fig. 6. *Micrograph (a) and energy dispersive spectrum (b) of a sample of γ-Al2O3 coated with bioglass.*

Thus, the method of pyrolysis of organic solutions makes it possible to obtain glasses of various compositions. By changing the composition, you can give the materials the necessary properties. The method is applicable for the production of powder materials, as well as coatings on various porous substrates. Compositions of 0, 5, 15 wt.% B_2O_3 are known in medicine - these are bioglasses "Bioglass 45S5", "Bioglass 40S5B5" and "Bioglass 45B15S5", respectively. The biological material can slowly release boron ions and serve as a bone repair material used for bone and periodontal engineering.

References

1. Rahaman M.N., Day D.E. , Bal B.S., Fu Q., Jung S.B., Bonewald L.F., Tomsia A.P. Bioactive glass in tissue engineering // Acta Biomater. 2011. V. 7. N 6. P. 2355–2373. doi 10.1016/j.actbio.2011.03.016

2. Kaur G., Pandey O.P. , Singh K., Homa D., Scott B., Pickrell G. A review of bioactive glasses: their structure, properties, fabrication and apatite formation // J. Biomed. Mater. Res.: A. 2014. V. 102. N 1. P. 254–274. doi 10.1002/jbm.a.34690

3. El-Rashidy A.A., Roether J.A., Harhaus L., Kneser U., Boccaccini A.R. Regenerating bone with bioactive glass scaffolds: a review of in vivo studies in bone defect models // Acta Biomater. 2017. V. 62. P. 1–28. doi 10.1016/j.actbio.2017.08.030

4. Hench L.L. . Opening paper 2015- some comments on bioglass: four eras of discovery and development // Biomedical Glasses. 2015. V. 1. N 1. P. 1–11. doi 10.1515/bglass-2015-0001

5. Balasubramanian P., Buttner T., Miguez P.V., Boccaccini A.R. Boron-containing bioactive glasses in bone and softtissue engineering // J. Eur. Ceram. Soc. 2018. V. 38. N 3. P. 855–869. doi 10.1016/j.jeurceramsoc.2017.11.001

6. Wu C., Chang J. Multifunctional mesoporous bioactive glasses for effective delivery of therapeutic ions and drug/growth factors // J. Control Release. 2014. V. 193. P. 282–295. doi 10.1016/j.jconrel.2014.04.026

7. Sych O., Gunduz O., Pinchuk N., Stan G.E., Oktar. Tissue engineering scaffolds from La_2O_3-hydroxyapatite/boron glass composites // J. Austral. Ceram. Soc. 2016. V. 52. P. 103–110.

8. Yang Q., Chen S., Shi H., Xiao H., Ma Y. In vitro study of improved wound-healing effect of bioactive borate-based glass nano/micro-fibers // Mater. Sci. Engin.: C. 2015. V. 55. P. 105–107. doi 10.1016/j.msec.2015.05.049

9. Medkov M. A., Grishchenko D. N., Rudnev V. S., Kuryavyi V. G., Gordienko P. S. Formation of Glass-Ceramic Coatings on Bioinert Substrates // Glass and Ceramics. 2014. V. 70. Iss. 11-12. P. 417. doi 10.1007/s10717-014-9593-2

10. Medkov M. A., Grishchenko D. N., Kuryavyi V. G., Slobodyuk A. B. Tungsten-Containing Bioactive Radiocontrast Glass: Production and Properties // Glass and Ceramics. 2018. V. 75, Iss. 7–8. P. 322. doi 10.1007/s10717-018-0079-5

11. Solonenko A.P., Blesman A.I., Polonyankin D.A., Gorbunov V.A. Synthesis of Calcium Phosphate and Calcium Silicate Composites // Russian Journal of Inorganic Chemistry. 2018. V. 63. № 8. P. 993. doi 10.1134/S0036023618080211

DOI 10.34660/INF.2020.60.86.020

放射性核素清洁土壤的过程
PROCESSES OF SOIL CLEANING FROM RADIONUCLIDES

Mammadov Khagani Farzulla oglu
Doctor of Chemical Sciences, Head of laboratory "Radiochemistry"
Institute of Radiation Problems of the National Academy of Sciences of Azerbaijan
Shiraliyeva Hajar Nuhbala qizi
Junior scientist
Institute of Radiation Problems,
National Academy of Sciences of Azerbaijan

抽象。 对土壤样品进行了全面的物理化学分析。 研究了土壤样品中痕量天然放射性核素的分布。 在所有土壤样品中均鉴定出K40，Na22，Sr91放射性同位素。 研究了被放射性核素污染的土壤的清洁方法。 通过系统研究确定，使用所有清洁方法，从土壤样品中提取K40的程度要比Na22和Sr91的释放低3-8倍。 通过用弱酸性和弱碱性溶液萃取从放射性核素中清除土壤的方法比使用吸附剂的清洁方法更有效。 正确应用此方法可使我们恢复土壤肥力。

关键词：天然放射性核素，土壤的清洁方法，重金属，萃取。

Abstract. *A comprehensive physical-chemical analysis of soil samples were carried out. The distributions of trace amounts of natural radionuclides in soil samples were studied. The K^{40}, Na^{22}, Sr^{91} radioisotopes were identified in all soil samples. The cleaning methods of soil contaminated with radionuclides have been studied. By systematic studies have determined that with all cleaning methods, the degree of K^{40} extraction from soil samples is 3-8 times lower than the release of Na^{22} and Sr^{91}. The method of cleaning the soil from radionuclides by extraction with weak acidic and alkaline solutions is more effective than cleaning methods using adsorbents. The correct application of this method allows us to restore soil fertility.*

Keywords: *Natural radionuclides, cleaning methods of soil, heavy metals, extraction.*

The processing of minerals by outdated technological processes and the consequent pollution of environmental objects with small amounts of xenobiotics can cause the formation of ecological crisis zones. Therefore, there is a need for

systematic measurements and studies to obtain results on the distribution of radionuclides, heavy metals and other xenobiotics in the soil of the country. The accumulation of large amounts of harmful substances in the soil causes the risk of their entry into living organisms by migration paths along the soil-water-vegetation chain [1].

The ability to clean by various methods local areas of the earth contaminated with radionuclides and heavy metals and to study the options for implementing these processes are the most important tasks of chemistry and are important for solving many pressing environmental problems [2].

In order to study changes in environmental objects and determine the degree of pollution of soil in the country, by the staff of the Radiochemistry laboratory of the Institute of Radiation Problems of the Azerbaijan National Academy of Sciences has systematically taken numerous samples of soil and carried out comprehensive analytical-chemical, radiometric examination of these samples in stationary laboratory conditions.

1. Material and methods

The laboratory staff took soil samples from the city of Sumgait as the most typical example for the region. The soil samples taken were treated with distilled water, weak solutions of acid and alkali with periodic mixing and filtration . Radiometric measurements were carried out using the İnSpector-1000 and Radiagem-2000 radiometers (manufactured by Canberra and equipped with alpha, beta and gamma detectors) and the İdentiFİNDER radiometer identifier (manufactured by Thermo Scientific). Gamma spectrometer with HPGe detector (manufactured by “Canberra”), atomic absorption AA-6800 spectrometer (manufactured by ”Shimadzu”), Expert-3L and XRF X-ray fluorescence spectrometers were used in the process of physical-chemical analysis of minerals obtained by evaporation of weakly acid and weakly alkaline extracts of soil samples [3].

2. Discussions of the results

Soil samples taken from the territory of the city of Sumgait are typical for most regions of Azerbaijan. The activity of the radionuclides detected by gamma spectroscopy in soil samples are shown in Table 1.

Table 1

Results of radiometric measurements and activity of radionuclides in soil samples taken from the city of Sumgait

Region (background μZv / h; alpha rays Bq_{eq} / sm^2)	Isotopes, Bq / kq									
	$_{11}Na^{22}$	$_{19}K^{40}$	$_{26}Fe^{60}$	$_{27}Co^{57}$	$_{30}Zn^{65}$	$_{38}Sr^{91}$	$_{50}Sn^{113}$, $_{50}Sn^{126}$	$_{63}Eu^{152}$, $_{63}Eu^{154}$	$_{88}Ra^{226}$	$_{90}Th^{228}$
Sumgait (0,08; 0,01)	1,0	1,7	0,46	0,47	0,16	0,36	0,2; 0,2	0,34; 0,30	0,37	0,05

Extraction of 0.2 kg soil samples with acid and alkaline solutions in distilled water (0.5 M, 1.0 M, 1.4 M, 2.0 M) led to the decrease of concentrations of radionuclides in analyzed soil samples. Weak solutions of acids and alkalis were used for the separation of heavy metals from soil samples.

The values of the activity of radioisotopes K^{40}, Na^{22} and Sr^{91} measured by the method of gamma spectroscopy in soil samples weighing 200 grams, taken from the territory of the city of Sumgait, were 1.4, 0.8, and 0.3 Bq, respectively. The values of the activity of these radioisotopes in the extracts obtained by treating soil samples with different solutions of acids and alkalis, as well as the values of the activity of these radioisotopes in the remains of soil samples after their treatment with solutions, were measured by gamma spectroscopy. A decrease in the activity value (in %) of these radioisotopes in the remains of soil samples and an increase in the activity value in extracts are shown in Tables 2-10.

Table 2

The content of the radioisotope K^{40} in extracts obtained by extraction (with solutions of nitric acid in distilled water) of soil samples taken from the territory of the city of Sumgait and in the remains of soil samples.

HNO_3 content in solutions, (mol)	**Content of radioisotope K^{40}, % (from the initial content (1,4 Bq = 100%) of K^{40} in soil samples weighing 200 g)**			
	Soil sample	**Soil extract with HNO_3 solutions in 1 liter of water / in soil residue**	**Soil extract with HNO_3 solutions in 2 liter water / in soil residue**	**Soil extract with HNO_3 solutions in 3 liter water / in soil residue**
-	100	-	-	-
0,5	-	1,2 / 98,8	2,4 / 97,6	4,1 / 95,9
1,0	-	2,4 / 97,6	4,7 / 95,3	7,0 / 93
1,4	--	4,1 / 95,9	7,0 / 93,0	10 / 90
2,0	-	7,6 / 92,6	9,4 / 90,6	13 / 87

Table 3

The content of the radioisotope K^{40} in extracts obtained by extraction (with solutions of NaOH in distilled water) of soil samples taken from the territory of the city of Sumgait and in the remains of soil samples.

NaOH content in solutions, (mol)	Content of radioisotope K^{40}, % (from the initial content (1,4 Bq = 100%) of K^{40} in soil samples weighing 200 g)			
	Soil sample	Soil extract with NaOH solutions in 1 liter of water / in soil residue	Soil extract with NaOH solutions in 2 liter water / in soil residue	Soil extract with NaOH solutions in 3 liter water / in soil residue
-	100	-	-	-
0,5	-	2,4 / 97,6	3,5 / 96,5	5 / 95
1,0	-	4,1 / 95,9	6,5 / 93,5	9 / 91
1,4	--	5,9/ / 94,1	8,8 / 91,2	12 / 88
2,0	-	8,8 / 91,2	11,8 / 88,2	14 / 86

Table 4

The content of the radioisotope K40 in extracts obtained by extraction (with solutions of HNO3 + HCl mixtures in distilled water) soil samples taken from the territory of Sumgait and in the remains of soil samples. Soil residues treated with 3 liter solutions of a mixture of acids were re-treated with alkaline solutions.

Acid or alkaline content in solutions, (mol)			Content of radioisotope K^{40}, % (from the initial content (1,4 Bq = 100%) of K^{40} in soil samples weighing 200 g)				
HNO_3	HCl	NaOH	Soil sample	Soil extract with HNO_3 + HCl mixtures solutions in 1 liter of water / in soil residue	Soil extract with HNO_3 + HCl mixtures solutions in 1 liter of water / in soil residue	Soil extract with HNO_3 + HCl mixtures solutions in 1 liter of water / in soil residue	Soil residues (treated with 3 liter solutions of a mixture of acids) re-treated with alkaline solutions.
-	-	-	100	-	-	-	-
0,5	0,5	0	-	3,5 / 96,5	5,9 / 94,1	8 / 92	-
1,0	1,0	0	-	7,1 / 98,9	11,8 / 88,2	17 / 83	-
1,4	1,4	0	-	8,8 / 91,2	17,6 / 82,4	24 / 76	-
2,0	2,0	0	-	12,4 / 87,6	23,5 / 76,5	29 / 71	-
0	0	0,5	-	-	-	-	(8) +4 / 88
0	0	1,0	-	-	-	-	(17) +6 / 77
0	0	1,4	-	-	-	-	(24) +7 / 70
0	0	2,0	-	-	-	-	(29) +8 / 63

Table 5

The content of the radioisotope Na22 in extracts obtained by extraction (with solutions of nitric acid in distilled water) of soil samples taken from the territory of the city of Sumgait and in the remains of soil samples.

HNO_3 content in solutions, (mol)	**Content of radioisotope Na^{22}, % (from the initial content (0.8 Bq = 100%) of Na^{22} in soil samples weighing 200 g)**			
	Soil sample	**Soil extract with HNO_3 solutions in 1 liter of water / in soil residue**	**Soil extract with HNO_3 solutions in 2 liter water / in soil residue**	**Soil extract with HNO_3 solutions in 3 liter water / in soil residue**
-	100	-	-	-
0,5	-	8 / 92	14 / 86	20 / 80
1,0	-	15 / 85	25 / 75	36 / 64
1,4	--	20 / 80	34 / 66	50 / 50
2,0	-	30 / 70	48 / 52	60 / 406

Table 6

The content of the radioisotope Na22 in extracts obtained by extraction (with solutions of NaOH in distilled water) of soil samples taken from the territory of the city of Sumgait and in the remains of soil samples.

NaOH content in solutions, (mol)	**Content of radioisotope Na^{22}, % (from the initial content (0.8 Bq = 100%) of Na^{22} in soil samples weighing 200 g)**			
	Soil sample	**Soil extract with NaOH solutions in 1 liter of water / in soil residue**	**Soil extract with NaOH solutions in 2 liter water / in soil residue**	**Soil extract with NaOH solutions in 3 liter water / in soil residue**
-	100	-	-	-
0,5	-	20 / 80	30 / 70	37 / 63
1,0	-	46 / 54	56 / 44	60 / 40
1,4	--	60/ / 40	74 / 26	77 / 23
2,0	-	77 / 23	83 / 17	86 / 14

Table 7

The content of the radioisotope Na22 in extracts obtained by extraction (with solutions of HNO3 + HCl mixtures in distilled water) soil samples taken from the territory of Sumgait and in the remains of soil samples. Soil residues treated with 3 liter solutions of a mixture of acids were re-treated with alkaline solutions.

Acid or alkaline content in solutions, (mol)			**Content of radioisotope Na^{22}, % (from the initial content (0.8 Bq = 100%) of Na^{22} in soil samples weighing 200 g)**				
HNO_3	**HCl**	**NaOH**	**Soil sample**	**Soil extract with HNO_3 + HCl mixtures solutions in 1 liter of water / in soil residue**	**Soil extract with HNO_3 + HCl mixtures solutions in 1 liter of water / in soil residue**	**Soil extract with HNO_3 + HCl mixtures solutions in 1 liter of water / in soil residue**	**Soil residues (treated with 3 liter solutions of a mixture of acids) re-treated with alkaline solutions.**
-	-	-	100	-	-	-	-
0,5	0,5	0	-	27 /73	32 / 68	36 / 64	-
1,0	1,0	0	-	51 / 49	61 / 39	70 / 30	-
1,4	1,4	0	-	70 / 30	78 / 22	84 / 16	-
2,0	2,0	0	-	80 / 20	85 / 15	90 / 10	-
0	0	0,5	-	-	-	-	(36) +4 / 60
0	0	1,0	-	-	-	-	(70) +5 / 25
0	0	1,4	-	-	-	-	(84) +6 / 10
0	0	2,0	-	-	-	-	(90) +6 / 4

Table 8

The content of the radioisotope Sr91 in extracts obtained by extraction (with solutions of nitric acid in distilled water) of soil samples taken from the territory of the city of Sumgait and in the remains of soil samples.

HNO_3 content in solutions, (mol)	**Content of radioisotope Sr^{91},% (from the initial content (0.3 Bq = 100%) of Sr^{91} in soil samples weighing 200 g)**			
	Soil sample	**Soil extract with HNO_3 solutions in 1 liter of water / in soil residue**	**Soil extract with HNO_3 solutions in 2 liter water / in soil residue**	**Soil extract with HNO_3 solutions in 3 liter water / in soil residue**
-	100	-	-	-
0,5	-	5,5 / 94,5	8 / 92	11 / 89
1,0	-	8,5 / 91,5	15 / 85	20 / 80
1,4	--	13,5 / 86,5	20 / 80	27 / 73
2,0	-	19 / 81	30 / 70	39 / 61

Table 9

The content of the radioisotope Sr91 in extracts obtained by extracting soil samples taken from the territory of the city of Sumgait with alkaline solutions of NaOH in distilled water and in the remains of soil samples.

NaOH content in solutions, (mol)	**Content of radioisotope Sr^{91},% (from the initial content (0.3 Bq = 100%) of Sr^{91} in soil samples weighing 200 g)**			
	Soil sample	**Soil extract with NaOH solutions in 1 liter of water / in soil residue**	**Soil extract with NaOH solutions in 2 liter water / in soil residue**	**Soil extract with NaOH solutions in 3 liter water / in soil residue**
-	100	-	-	-
0,5	-	6,8 / 93,2	11 / 89	13,5 / 86,5
1,0	-	16 / 84	22 / 78	27 / 73
1,4	--	22 / 78	30 / 70	38 / 62
2,0	-	30 / 70	41 / 59	51 / 49

When soil samples were treated with solutions of 0.5, 1.0, 1.4, 2.0 mol of nitric acid in 1, 2, and 3 liters of distilled water, a decrease in the value of K^{40} activity in soil from 100% to 87% and an increase in the value of K^{40} activity in extracts from 0% to 13% were observed. ... With such treatment of soil samples with solutions of sodium hydroxide (caustic sodium), a decrease in the value of K^{40} activity in the soil from 100% to 86% and an increase in the value of K^{40} activity in extracts from 0% to 14% and with a similar treatment of soil samples with solutions of a mixture of nitric acid with hydrochloric acid, as well as further processing of the soil residue with a solution of sodium hydroxide (sodium hydroxide), a decrease in the value of K^{40} activity in the soil from 100% to 64% and an increase in the value of K^{40} activity in the extracts from 0% to 36% were observed.

Table 10

The content of the radioisotope Sr^{91} in extracts obtained by extraction (with solutions of HNO3 + HCl mixtures in distilled water) soil samples taken from the territory of Sumgait and in the remains of soil samples. Soil residues treated with 3 liter solutions of a mixture of acids were re-treated with alkaline solutions.

Acid or alkaline content in solutions, (mol)			Content of radioisotope Sr^{91}, % (from the initial content (0.3 Bq = 100%) of Sr^{91}in soil samples weighing 200 g)				
HNO_3	HCl	NaOH	Soil sample	Soil extract with HNO_3 + HCl mixtures solutions in 1 liter of water / in soil residue	Soil extract with HNO_3 + HCl mixtures solutions in 1 liter of water / in soil residue	Soil extract with HNO_3 + HCl mixtures solutions in 1 liter of water / in soil residue	Soil residues (treated with 3 liter solutions of a mixture of acids) re-treated with alkaline solutions.
-	-	-	100	-	-	-	-
0,5	0,5	0	-	16 / 84	22 / 78	27 / 73	-
1,0	1,0	0	-	30 / 70	43 / 57	54 / 46	-
1,4	1,4	0	-	41 / 59	62 / 38	73 / 27	-
2,0	2,0	0	-	62 / 38	73 / 27	84 / 16	-
0	0	0,5	-	-	-	-	(27) +5 / 68
0	0	1,0	-	-	-	-	(54) +8 / 38
0	0	1,4	-	-	-	-	(73) +13 / 14
0	0	2,0	-	-	-	-	(84) +13 / 3

When soil samples were treated with solutions of 0.5, 1.0, 1.4, 2.0 mol of nitric acid in 1, 2, and 3 liters of distilled water, a decrease in the value of Na^{22} activity in soil from 100% to 40% and an increase in the value of Na^{22} activity in extracts from 0% to 60% were observed. By such treatment of soil samples with solutions of sodium hydroxide, a decrease in the value of Na^{22} activity in soil from 100% to 14% and an increase in the value of Na^{22} activity in extracts from 0% to 86% and by similar treatment of soil samples with solutions of a mixture of nitric acid with hydrochloric acid, as well as further processing of the soil residue with sodium hydroxide solution, a decrease in the value of Na^{22} activity in soil from 100% to 5% and an increase in the value of Na^{22} activity in extracts from 0% to 95% were observed.

When soil samples were treated with solutions of 0.5, 1.0, 1.4, 2.0 mol of nitric acid in 1, 2, and 3 liters of distilled water, a decrease in the value of Sr^{91} activity in soil from 100% to 61% and an increase in the value of Sr^{91} activity in extracts from

0% to 39% were observed. By such treatment of soil samples with solutions of sodium hydroxide, a decrease in the value of Sr^{91} activity in the soil from 100% to 49% and an increase in the value of Sr^{91} activity in extracts from 0% to 51% were observed, and by similar treatment of soil samples with solutions of a mixture of nitric acid with hydrochloric acid, as well as further processing of the soil residue with a solution of sodium hydroxide, a decrease in the value of Sr^{91} activity in the soil from 100% to 3% and an increase in the value of Sr^{91} activity in the extracts from 0% to 97% were observed.

Thus, cleaning the soil from radioisotopes with a mixture of nitric acid with hydrochloric acid with further processing of the rest of the soil with sodium hydroxide solutions is the most effective method of cleaning.

Comparative analysis of the results of these experiments with the data of previous experiments using traditional adsorbents concluded that the cleaning of soil contaminated with radioisotopes is effective by sequentially treating it with solutions of weak acids and alkalis [4].

Comparative analysis of the data presented in tables 2-10 confirms about 3-8 times low degree of K^{40} emission in comparison with the degree of soil purification from other radionuclides / Na^{22}, Sr^{91} /.

The method of cleaning the soil from heavy metals and radionuclides by extraction with weak acidic and alkaline solutions is more effective than cleaning methods using adsorbents. The correct application of this method allows us to restore soil fertility.

References

1. Matskevich A.V., Pronev V.V. Technologies for the rehabilitation of radioactively contaminated territories. Proceedings of the scientific conference, Sankt-Peterburq, (2017), p.226.

2. A.S. Piskunov, Methods of agrochemical research / Moscow, "Kolos", (2004).

3. Kh.F. Mamedov, Research of distribution of heavy metals and radioactive elements in sources of drinking water, soil and grass cover of Azerbaijan regions / Petrozavodsk, "Tsifra", (2020).

4. A.M.Gulamirov, Kh.F.Mammadov, H.N.Shiraliyeva, M.N.Mirzayev, G.R.Allahverdiyev, R.G.Garibov, B.F.Ahmadov, N.A.Mirzayev. The study of adsorption of uranium isotopes in anthracite and activated carbon mass for water purification. Journal of Radiation Researches. Baku, ANAS, Institute of Radiation Problems, 2018, Vol.5, No2, pp. 328-332.

DOI 10.34660/INF.2020.21.78.021

测试车载电子设备的温度影响
TESTING ON-BOARD ELECTRONIC EQUIPMENT FOR TEMPERATURE EFFECTS

Bykov Alexey Petrovich
Postgraduate
Samara University, Samara, Russia
Denisyuk Alina Alekseevna
Postgraduate
Samara University, Samara, Russia

抽象。 描述了测试航天器的机载无线电电子装置的温度影响的方法。 它们是在设计和开发测试的框架内对已通过验收测试的样品进行的。 测试的主要目的是开发设计文档，以分配所需的字母并确认元素库的正确使用。 给出了测试结果。

关键字：无线电电子手段，测试，温度影响，设计文档，测试，文学

Abstract. *The method of testing the onboard radio-electronic means of spacecraft for temperature effects is described. They were carried out within the framework of design and development tests for samples that have passed acceptance tests. The main purpose of the tests was the development of design documentation for assigning the required letter and confirmation of the correct use of the element base. The test results are presented.*

Keywords: *radio electronic means, tests, temperature effects, design documentation, testing, litera*

Introduction

Ground-based experimental development of radio electronic equipment (RES) for spacecraft (SC) is an important stage in the process of its design with a given quality and reliability. It must provide confirmation of the compliance of its characteristics with the required values, which are given in the terms of reference, as well as the availability of the necessary stocks.

In the process of ground experimental development of samples, various tests are carried out [1-4]. One of the most important tasks of any tests is the simulation in the experiment of such modes that best meet the real conditions of their operation [2].

At this stage, much attention is paid to improving tests for temperature effects. In some cases, it is advisable to carry out thermal vacuum tests RES [5], when tests for thermal effects and low pressure effects are combined. However, for many types of on-board equipment, it is recommended to test for exposure to low and high ambient temperatures. In this case, the choice of operating temperatures and other test conditions is ambiguous.

The purpose of this article is to develop and approbate in production conditions the RES SC test method for temperature effects at the stage of the technological project during the development of working documentation.

Test methodology

An electronic temperature controller (hereinafter referred to as the "device") was chosen as the object of testing. To select the test influences, an analysis of the specifications for this device was carried out. The device is installed on honeycomb panels in leaky SC compartments. It must remain operational when the temperature changes from -20 to + 40^{0}C. In addition, an analysis of previous tests of analog devices was carried out. With this in mind, a methodology and test program were proposed (table 1, columns 2 and 3). During the tests, the insulation resistance between the R_{IS} circuits (it should be more than 5MΩ) and the transition resistance between the structural elements R_T (it should be less than 1.2 mΩ) were monitored

Table 1 – *Sequence, types of actions and test results*

№	Scope and type of tests	Test conditions and modes	Test result
1	2	3	4
1	Test for the effects of low (high) temperature		Qualifies
1.1	Technical inspection without opening for mechanical damage	NI	Qualifies
1.2	Technical inspection with opening for mechanical damage	NI	Qualifies
1.3	Brush application of highly sensitive thermal indicators TMI-60, TMI-65, TMI-72, TMI-82	NI	Qualifies
1.4	Assembly and measurement of contact resistance	NI	R_{T1}<1,2 mΩ, R_{T2}<0,8 mΩ
1.5	Setting the low temperature limit for the medium	T_{AV}= minus (50^{+3})^{0}C	Qualifies
1.6	Exposure of the device at the extreme low temperature of the medium in the off state	Exposure time for cooling throughout the volume 28 h	Qualifies
1.7	Setting a reduced operating temperature	T_{WRK} = minus (20^{+3})^{0}C	Qualifies

1.8	Exposure of the device at a low operating temperature when switched off	Exposure time 4 h	Qualifies
1.9	Exposure of the device at a low operating temperature when switched on	Exposure time 4 h	Qualifies
1.10	Function check	T_{WRK} = minus $(20^{+3})^0$C	Qualifies
1.11	Checking for electrical insulation resistance	T_{WRK} = minus $(20^{+3})^0$C	R_{IS}>5 MΩ
1.12	Exposure of the device under normal conditions	NI	Qualifies
1.13	Checking for electrical insulation resistance	NI	Qualifies
1.14	Function check	NI	Qualifies
1.15	Establishing the maximum temperature of the medium	T_{AV}= $(50^{+3})^0$C	Qualifies
1.16	Exposure of the device at the maximum elevated temperature of the medium in the off state	Exposure time for heating throughout the entire volume 28 h	Qualifies
1.17	Setting a reduced operating temperature	T_{WRK} = $(40^{+3})^0$C	Qualifies
1.18	Exposure of the device at an elevated operating temperature in the off state	Exposure time 4 h	Qualifies
1.19	Keeping the device in the switched on state until thermal equilibrium is reached	T_{WRK} = $(40^{+3})^0$C	Qualifies
1.20	Function check	T_{WRK} = $(40^{+3})^0$C	Qualifies
1.21	Checking electrical insulation resistance	T_{WRK}= minus $(20^{+3})^0$C	R_{IS}>5 MΩ
1.22	Exposure of the device under normal conditions	NI Exposure time 4 h	Qualifies
1.23	Checking electrical insulation resistance	NI	Qualifies
1.24	Function check	NI	Qualifies
1.25	Technical inspection with opening for mechanical damage	NI	Qualifies
1.26	Measuring contact resistance	NI	R_{T1}<1,2 mΩ, R_{T2}<0,8 mΩ
1.27	Checking the electrical circuit	NI	Qualifies
1.28	Checking electrical insulation resistance	NI	
1.29	Function check	NI	Qualifies

Before the tests, thermal melting indicators (TMI) were applied to the electrical radio products (ERP) of the device boards to assess the heating temperature of the ERP. To control the achievement of thermal equilibrium, a TM232 sensor was installed on the device body.

The tests failed in the ATM2.708.005 chamber. The device was mounted on the heat-dissipating table of the chamber through heat-dissipating paste 131-179 and attached to the table with a bracket. To achieve thermal equilibrium, the device was kept switched on in the chamber. Inspection of the thermal indicators at the end of the tests revealed a change in the color of TMI-60 (became transparent) applied to the power module and the OSM1554LR13 microcircuit. The tests were continued as in fact, the temperature did not exceed 65 °C, which is below the permissible level.

Test results

Tests for temperature effects, carried out as part of design and development tests (DDT) according to the proposed method and program, showed that the developed device meets all the requirements of technical conditions and design documentation (column 4 of table 1). Remarks were made.

When opened after tests for high and low temperatures, dots, spots and streaks were found on the base of the device. This part was sent to CFL to determine the chemical composition of stains and streaks, the nature of the defect. The presence of corrosion products was confirmed by chemical analysis. The base was cleaned. The device was reassembled and testing continued. Based on this comment, a decision was made to introduce an anodic oxidized coating.

When checking the electrical modes of ERP, comments were received about the non-compliance with the requirements of the technical specifications of some values of the parameters given in the "Cards for assessing the ERP nomenclature and information on the compliance of their operating conditions and reliability indicators with the requirements of regulatory documents." In order to eliminate these inconsistencies, a notice was issued. An external examination of the "Sh 14" connector revealed a microcrack on the thin part of the insulator outside the terminal area. The reason for the occurrence of microcracks was recognized as a violation of the technology of connecting-disconnecting the connector at the stage of technological checks of the device. It was decided to revise the SNP339 connectors. The comment was reviewed and worked out at the bottom of quality. The defect was recognized as a single one, it does not affect the performance of the device. It is advisable to continue the DDT of the device.

A remark was made on the marking of the drawing and serial numbers on the boards. It is made in black enamel on a dark background. This makes the information difficult to read. The technological process was corrected in terms of replacing the black EP-51 enamel with white.

On a number of boards, improvements were found with a mounting wire, which lies on the ERP terminals. The wire lies in several layers, which makes it difficult to install the boards. The decision was made to redesign these boards and remove wiring from item №3.

Conclusion

The temperature test method was found to be effective. Taking into account the results of other tests, it was found that the device meets the requirements of the technical task. The characteristics specified in it at DDT were confirmed. Technological documentation has been worked out taking into account the comments. The design documentation has been checked and prepared for the assignment of the litera "0". The device was approved for flight tests as part of the product.

References

1. Fedorov V.K., Sergeev N.P., Kondrashin A.A. Control and testing in the design and production of radio electronic equipment // Moscow: Technosphere, 2005. – 504 P.

2. Liseikin V.A., Moiseev N.F., Frolov O.P. Foundations of test theory. Experimental development of rocket and space technology. – M.: Mechanical Engineering-Flight / Viart Plus, 2015. – 260 P.

3. Kolchanov I.P., Delkov A.V., Lavrov N.A., Kishkin A.A., Khodenkov A.A. Mathematical modeling of thermal tests of space vehicles using cryogenic screens. Bulletin of N.E. Bauman MSTU Ser. "Mechanical Engineering". – 2015. – №1. – P. 56-64.

4. Kolesnikov, A.V. Testing of structures and systems of spacecraft: course of lectures. – M.: Publishing house MAI, 2007. – 105 P.

5. Bykov, A.P., Androsov S.V., Piganov M.N. Technique of thermal vacuum testing of spacecraft instruments // Reliability and quality of complex systems. – 2019. – №3 (27). – P. 78-83.

DOI 10.34660/INF.2020.86.54.022

预测无线电电子设备质量和可靠性的算法和程序

ALGORITHM AND PROGRAM FOR FORECASTING QUALITY AND RELIABILITY OF RADIO ELECTRONIC DEVICES

Denisyuk Alina Alekseevna
Postgraduate

Bykov Alexey Petrovich
Postgraduate

Piganov Mikhail Nikolaevich
Doctor of Engineering Sciences, Full Professor

Samara University, Samara, Russia

抽象。 本文提出了一种通过潜在函数方法对无线电电子设备的质量和可靠性指标进行个体预测的算法和程序。 它们允许根据适用性类别对样品进行分类。 该程序由实现三个窗口对话框的三个模块组成。

关键词：算法，预测，无线电电子设备，可靠性，潜在功能，程序，模块，分类。

Abstract. *This article proposes an algorithm and a program for individual forecasting of indicators of the quality and reliability of radio electronic devices by the method of potential functions. They allow for the classification of samples according to the class of suitability. The program consists of three modules that implement three window dialogs.*

Keywords: *algorithm, forecasting, radio electronic devices, reliability, potential function, program, module, classification.*

Introduction

At present, one of the promising areas for improving the quality and reliability of radio electronic devices of spacecraft is the selection of electronic components and assemblies based on the results of individual forecasting (IF). Good forecasting results are provided by the method of potential functions (MPF) [1]. It allows for classification even in cases where the classes of "good" and "bad" samples have interpenetration. However, the known algorithms and programs in some cases do not provide the required prediction reliability.

The purpose of the work is to develop an algorithm and a forecasting program

to increase the reliability.

Development of the program algorithm

Theoretical information on MPF is given in [1]. The IF MPF result provides a classification of the specimens by fitness class. Based on the learning results, the conclusion is drawn: if the total potential induced on the *j*-th instance by all other samples of the sampling set is greater than a certain threshold value, then this instance is referred to the class K_1 - the class of suitable ones, if less - referred to the class K_2 - the class of unsuitable (unreliable).

$\sum_{j \in K_1}$ – total normalized potential;

$R^{(jl)}$ – the distance between the points of the *j*-th and *l*-th instance in the space of informative features;

$\varphi^{(jl)}$ – potential of the *j*-th instance, induced on it by the *l*-th instance;

$R^{(jl)}_0$ – generalized distance for all *k* features for *j*-th and *l*-th specimens.

Normalization is carried out either by the mathematical expectation of an informative parameter for all signs, or - by the standard deviation, the operation of normalization and centering of informative features is also carried out.

A block diagram explaining the algorithm for working with the program is shown in fig. 1.

At the first step, the values of the informative and predicted parameters selected on the basis of the analysis are entered (block 1). Then the values of the mathematical expectation, variance and standard deviation are calculated for all informative parameters (block 2). In block 3, standardization and centering of informative parameters are performed. Then (block 4) the distance and generalized distances between the values of the informative parameters are determined. In block 5, the induced potentials are calculated. After that, the total normalized potentials are calculated (block 6) and the classification threshold (block 7) of the potential function is determined.

After that, the samples are classified using the model (block 8). Then (block 9) probabilistic characteristics are calculated: the probabilities of correct and erroneous decisions, the risks of the consumer and the manufacturer, etc. (7 characteristics in total). At the next step (block 10), the results are analyzed. After that, the results are checked (block 11). If the result is not satisfactory, then a decision is made to adjust and the model is adjusted (block 12). If the results are satisfactory, then they are printed.

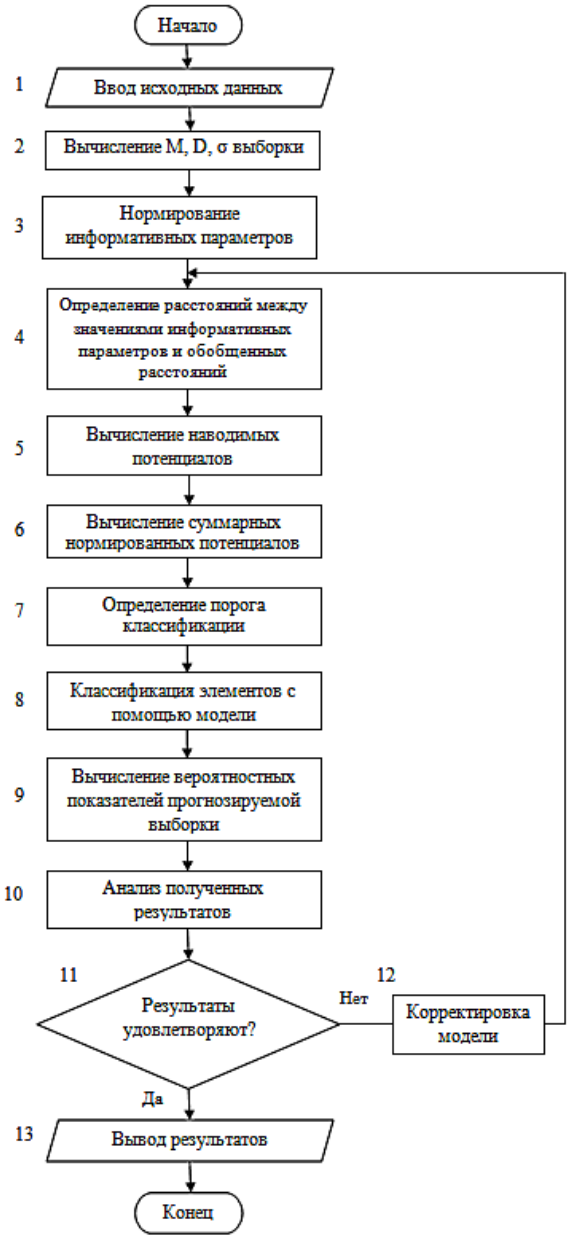


Figure 1 - *Block diagram of the IF algorithm*

Composition of program modules

The program consists of three modules: Focus1.pas, Focus2.pas, Focus3.pas, implementing respectively three window dialogs: launch form, functional form, help form.

Brief characteristics of the program:

– intuitive interface that meets the requirements of modern user programs [2];

– export-import of data into files.

Functionality of the program:

– reading data from a file and editing them;

– manually entering data into the program, editing data;

– normalization by mathematical expectation, variance, centering and normalization of the values of features entered into the file [2];

– calculation of the matrix of distances by features for different instances;

– calculation of the matrix of potentials for all instances;

– determination of the total potential for all specimens;

– setting the number of threshold values with an indication of their value;

– classification of specimens depending on the threshold value;

– calculation of probabilistic indicators: consumer risk, manufacturer risk, determination of the probability of making an erroneous decision and other indicators;

– graphic interpretation of probabilistic characteristics depending on the threshold level [3].

The Focus1.pas module contains the procedures responsible for the formation of the launch window interface and its functionality:

- Label1Click - launches a functional form for calculation;
- Label1MouseLeave and Label1MouseMove - change the color of the Label1 label when the mouse pointer is hovering over it;
- Label2MouseLeave and Label2MouseMove - change the color of the Label2 label when you hover the mouse pointer over it;
- Label2Click - close the program.
- The Focus2.pas module lists the main procedures:
- FormCreate - creating a functional form, defining the initial parameters of all variables that are used in the program;
- test () - setting up the program for forecasting the test sample;
- table () - setting the program for forecasting with a random sample, the parameters of which are indicated using controls on the form;
- matog (nachalo, konec: integer) - calculation of the mathematical expectation by columns, indicating the start and end column [4];
- disp (nachalo, konec: integer) - calculates the variance by columns indicating the starting and ending columns;

- norma (nachalo, konec: integer) - calculation of the normalized values of features by columns, indicating the initial and final columns of informative features [5];
- dlinaR (nachalo, konec: integer) - calculation of the matrix of distances between features for all instances of the sample;
- potencial (number: integer) - calculation of the potential matrix;
- sumpotencial (number, numbervihod: integer) - determination of the total potential for each instance;
- classi (number: integer) - counting the number of instances belonging to the first and second class, according to the results of the training experiment;
- sravnenie (i, k: integer; porog: real) - a procedure for determining the classification of specimens depending on the value of the threshold and the total potential;
- reshenia () - calculation of probabilistic characteristics based on learning outcomes;
- create_file (nameFile: string; numTable: integer) - writing selection data to a file;
- read_from_file (nameFile: string; numTable: integer) - reading data from a file;
- formatcell (acol, arow, numtable: integer) - checking the entered data, excluding entering a string instead of a number;
- proverka (num: integer) - check input data when specifying an instance class;
- mode (ishodnii, poprognozu: integer) - definition of numerical data for calculating probabilistic indicators;
- Label6MouseLeave and Label6MouseMove - change the color of Label6 when the mouse pointer is hovering over it;
- Label7MouseLeave and Label7MouseMove - change the color of the Label7 when the mouse pointer is hovering over it;
- Edit1Change - entering the number of sampling instances, checking the entered value;
- Edit2Change - entering the number of informative signs, checking the entered value;
- Edit3Change - entering the number of threshold values, checking the entered value;
- RadioButton1Click - selection of input of arbitrary selection;
- RadioButton1Click - formation of a test sample;
- Label7Click - forming tables for selection;
- Button1Click - calculation of the potential matrix;
- Button2Click - distance matrix calculation;
- Button4Click - normalization;
- Button3Click - classification based on learning outcomes;

– Button5Click - definition of mathematical expectation;
– Button6Click - variance detection;
– Button7Click - classification based on the results of the training experiment;
– Label6Click - closing the functional form;
– N4Click, N14Click, N12Click - procedures for working with elements of the main menu;
– StringGrid1SetEditText - checking the data entered into tables;
– RadioButton3Click - selection of data normalization and centering;
– RadioButton4Click - selection of standardization by mathematical expectation;
– RadioButton5Click - selection of standardization by standard deviation. Module Focus3.pas is intended for generating help information.

User guide

The program is launched by double clicking on the "MPF.exe" file, a dialog box is displayed on the monitor screen.

The form has two buttons: "Start", which calls the tab for setting the calculation form of the program, "Close", which terminates the program.

Setting up the program implies the choice of one of two modes of the program: "Input of initial data" and "Test mode".

The mode "Input of initial data" implies the indication of the number of copies and the characteristics of the sample for training, examinations and forecasting; for the program to work correctly, it is desirable to specify at least 10 threshold values.

In this operating mode, there are interfaces for setting the threshold values and the names of informative signs.

The "Test mode" mode is intended for quick viewing of the program's capabilities, in this case the user is provided with a selection of informative parameters.

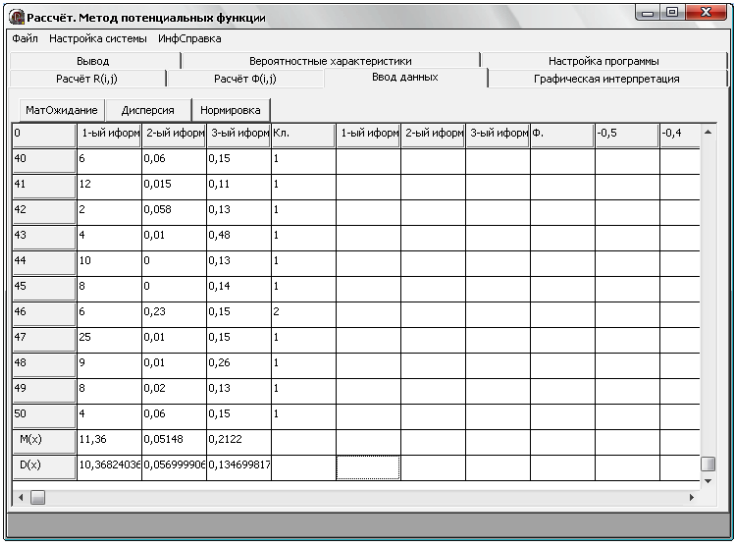
To go to the tab for entering and editing data, click on the "OK" button, to exit the program - on the "Close" button.

Data can be entered into the program either manually or by reading from a file; for this, a procedure for calling a standard open dialog is provided.

After the sample of initial data is formed, the calculation of the mathematical expectation, variance, standard deviation, normalization of features, calculation of the matrix of distances between features, calculation of the matrix of potentials, determination of the total potential, classification of each instance by the total potential relative to threshold values and calculation of probabilistic characteristics with graphic interpretation (fig. 2-4).

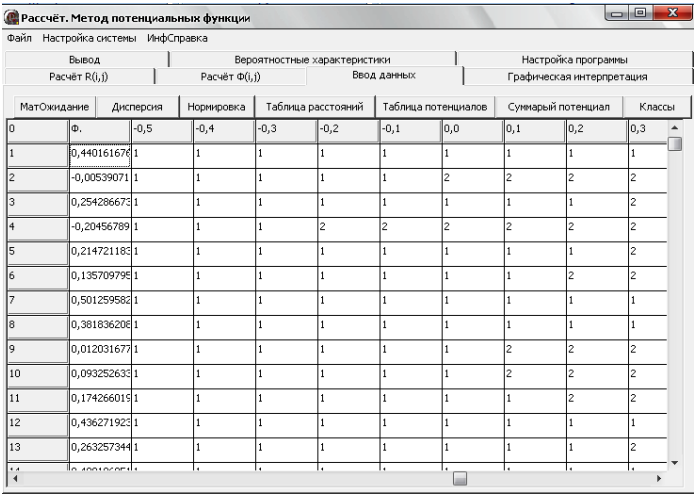
The principle of operation is intuitive.

The developed algorithm and program can be used to reject potentially unreliable ECB samples based on the results of individual prediction of their parameters at the stage of incoming control during the manufacture of spacecraft equipment.



0	1-ый иформ	2-ый иформ	3-ый иформ	Кл.	1-ый иформ	2-ый иформ	3-ый иформ	Ф.	-0,5	-0,4
40	6	0,06	0,15	1						
41	12	0,015	0,11	1						
42	2	0,058	0,13	1						
43	4	0,01	0,48	1						
44	10	0	0,13	1						
45	8	0	0,14	1						
46	6	0,23	0,15	2						
47	25	0,01	0,15	1						
48	9	0,01	0,26	1						
49	8	0,02	0,13	1						
50	4	0,06	0,15	1						
M(x)	11,36	0,05148	0,2122							
D(x)	10,36824036	0,056999906	0,134699817							

Figure 2 – *Calculation of sample characteristics*



0	Ф.	-0,5	-0,4	-0,3	-0,2	-0,1	0,0	0,1	0,2	0,3
1	0,440161676	1	1	1	1	1	1	1	1	1
2	-0,00539071	1	1	1	1	1	2	2	2	2
3	0,254286673	1	1	1	1	1	1	1	1	2
4	-0,20456789	1	1	1	2	2	2	2	2	2
5	0,214721183	1	1	1	1	1	1	1	1	2
6	0,135709795	1	1	1	1	1	1	1	2	2
7	0,501259582	1	1	1	1	1	1	1	1	1
8	0,381836208	1	1	1	1	1	1	1	1	1
9	0,012031677	1	1	1	1	1	1	2	2	2
10	0,093252633	1	1	1	1	1	1	2	2	2
11	0,174266019	1	1	1	1	1	1	1	2	2
12	0,436271923	1	1	1	1	1	1	1	1	1
13	0,263257344	1	1	1	1	1	1	1	1	2

Figure 3 – *Calculation of the total potential and classification of specimens by class of suitability*

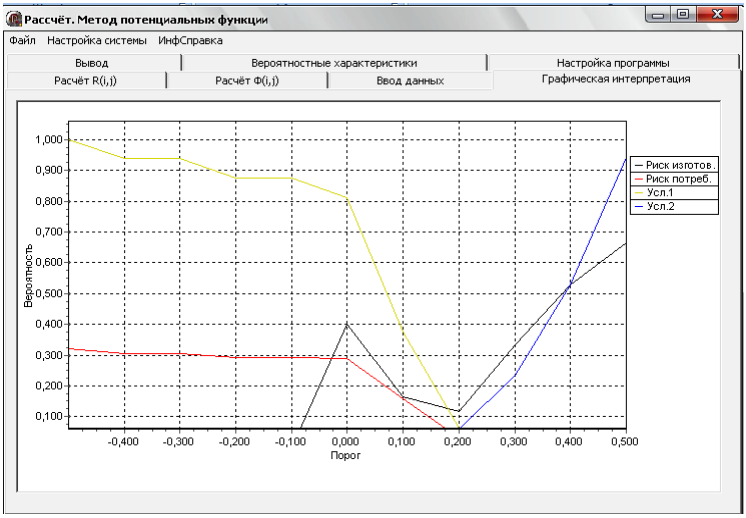


Figure 4 – *Graphical interpretation*

References

1. Piganov, M.N. Individual prediction of quality indicators for elements and components of micro-assemblies. – M.: New technologies, 2002. – 267 P.

2. Delphi programming lessons [Electronic resource] - http://www.delphiexpert.ru

3.Delphi in questions and answers [Electronic resource] - http://decoding.narod.ru/link/main.html

4.Programming in the Delphi language [Electronic resource] - http://www.interface.ru/borland/progrdelphi_predisl.htm

5. Materials on Delphi [Electronic resource] - http://www.programmersclub.ru/help

DOI 10.34660/INF.2020.58.42.023

冬季使用电缆系统和太阳能电池板在人行道上行人安全
TRAFFIC SAFETY ENSURANCE ON A PEDESTRIAN SIDEWALKS IN WINTER CONDITIONS USING A CABLE SYSTEM AND SOLAR PANELS

Rogulina Darya Aleksandrovna
undergraduate
Perm National Research Polytechnic University
Panina Ksenia Sergeevna
undergraduate
Perm National Research Polytechnic University
Burgonutdinov Albert Masgutovich
Doctor of Technical Sciences
Perm National Research Polytechnic University

抽象。 可以根据国家，城市的位置和能力，以不同的方式来对抗打滑。俄罗斯的最佳选择是使用电缆系统和太阳能电池板的人行道供暖。

关键字：加热的人行道，行人安全，太阳能电池板。

Abstract*. Fighting slipperiness can be done in different ways, depending on the location and capabilities of the country, city. The best option for Russia is sidewalk heating using a cable system and solar panels.*

Keywords*: Heated sidewalks, pedestrian safety, solar panels.*

Today, one of the urgent problems is the safety of pedestrians not only on the roads, but also on the sidewalks. Due to various weather events, unfavorable conditions are created for their movement. Such phenomena include: snowfall, ice, rain with temperature changes, etc.

In Russia, various methods are used to combat them. To eliminate icing, a friction method is used, which consists in placing a sand mixture, which leads to high costs for material, equipment, labor, as well as environmental pollution. While in countries (Canada; USA; Finland; Norway; Iceland; Japan) with similar natural phenomena, they resort to using installations that melt snow and ice.

For example, in Iceland, walkways are naturally heated from geothermal sources, and in the US, cable systems are used.

What kind of heating system that ensures safety on pedestrian paths can be cre-

ated in Russia? If geothermal sources are not ubiquitous in this country, the energy of the ebb and flow is not all available, and the creation of wind farms requires large costs and areas, which is inconvenient in an urban environment. Electricity can be used, but it also has several disadvantages. What then remains? Another inexhaustible source is the energy of the sun, which can be converted into electricity thanks to solar panels.

The use of solar panels abroad is quite widespread from their use in everyday life to their use as the top layer of a road surface. While in Russia they are used as a source of energy to power the elements of road improvement (traffic lights, road signs, bus stops).

Now let's move on to consider the principle of operation of the cable system, which consists in heating open areas with a heating cable.

Cable heating of sidewalk paths consists of:

- heating cable of fixed power and a certain length;
- metal mounting tapes for fixing cables or reinforcing mesh;
- protective corrugated pipes for connecting the system;
- sleeves and plastic tubes for installing humidity and temperature sensors;
- geotextile or sand layer to protect the cable;
- heat-reflecting film;
- regulator to control the system.

The construction of a warm sidewalk can be of different types:

1. A heat-reflecting film is laid on the previously prepared base, on which there is a metal tape on which the heating cable is attached. Then a protective layer of geotextile material and sand is arranged. Then the paving slabs or paving stones are laid (fig. 1).

2. Asphalt concrete is laid on the compacted base, then treated with bitumen or bitumen emulsion to fix the heat-reflecting film. The heating system is fixed on it using a reinforcing mesh. After that, a protective layer and a layer of asphalt concrete mixture are laid.

3. Installation of heating is carried out according to the second scheme, but instead of a layer of asphalt concrete, tiles or paving stones are laid. (fig. 3).

***Fig. 1** First type*

***Fig. 2** Second type*

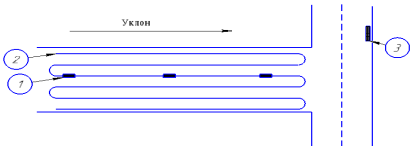
***Fig. 3** Third type*

In the presented types, a heat-reflecting film with aluminum sputtering (metallized) is used, which reflects heat well and is protected from corrosion. In this design, it helps to avoid the loss of heat going into the underlying layers of the

structure, which allows it to be directed to the coating, accelerating the thawing and drying.

The structure must provide surface runoff so that melt water does not penetrate into the lower layers of the pavement. When moisture seeps into the layers of the footpath, thanks to the heat-reflecting film and the slope, it does not stagnate and is discharged into the drainage system.

When arranging sidewalks, it is better to lay cables in the direction of the slope so that the melt water does not linger between the laid cable (fig. 4). It can be collected in trays on the roadway or on a lawn area.



1- temperature and precipitation sensor,
2- heating cable,
3- drainage system

Fig. 4 *Example of cable laying.*

As an example of calculating a cable heating system, a sidewalk path in the Russian Federation, Perm Krai, the city of Perm, Komsomolsky Prospect, 29, near the main building of PNRPU is considered. This site has a natural slope, which ensures water flow into the established catchment area on the roadway of st. Ekaterininskaya (Perm).

Initial data for the calculation: area (S) = 1,084.4 m^2; Pp = 200 W/m^2 (installed power of cable systems for sidewalks);

Full power calculation:

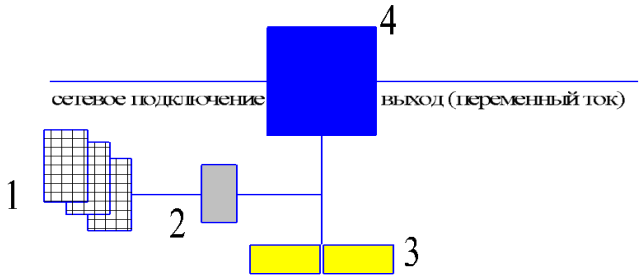
$$P = P_p \cdot S \quad (1)$$

$$P = 200 \cdot 1\,084{,}4 = 216{,}88 \text{ kW}$$

For further research and calculations, we accept the cable of the "IceFree-O 110-3330" brand.

In order to save energy and reduce costs, we install solar panels, placing them on lighting masts.

With the help of photovoltaic panels, solar radiation is converted into direct electric current. With the help of a cable, they are connected to a battery charge controller, which regulates its level, and also acts as a fuse. The next in the chain is the battery, which acts as a reserve for supplying energy in unforeseen situations (in the event that the accumulated power is not enough, it will come from the mains). The inverter closes the chain - a device that converts the constant voltage of the batteries into alternating voltage to increase the current strength.



1 - Solar battery
2 - Charge controller
3 - Battery
4 - Inverter

Fig. 5 *Construction of a solar power plant*

Based on the analysis of the meteorological data of the Perm Krai for 2019-2020, 13 temperature drops, 8 sunny days, 14 low-cloud, 200 cloudy days, were revealed in the period 09.01.2019 to 03.31.2020. Taking into account these data, the average duration of work per day (t) was taken - 10 minutes (0.17 h).

Calculation of electricity consumption (Q) spent on the heating of the sidewalk:

$$Q = P*t \quad (2)$$

$$Q=216,88 * 0,17*13=479,31 \text{ kWh}$$

We accept solar batteries SilaSolar SIM350 PERC (5BB) with parameters:

- power 350 watts;
- average annual electricity generation 1.65 kWh/day;
- service life not less than 30 years
- dimensions 1956x993x40 mm;

Taking into account the average annual electricity generation on sunny days, we get 13.2 kWh/day. In low-cloud weather, energy production is reduced by 2 times, based on this, 11.55 kWh/day is obtained. And in cloudy weather - it decreases 15 times, so 22 kWh/day comes out.

The average operating time of a solar battery is 7 hours a day.

Determination of the generated power of one solar battery for the period under consideration:

$$P_b = (13,2+11,55+22)*7=327,25 \text{ kWh/day}$$

Number of batteries (n):

$$n= Q/P_b \quad (3)$$

$$n= 479,31/327,25=1,46$$

Based on the results of the calculation, it can be concluded that 2 solar batteries are needed, and if we take into account the indirect energy losses in the battery, the received averaged data, as well as changes in meteorological data in subsequent years, the number of batteries can be increased to 3 pieces with a power reserve of 50%.

In order to visually show the costs of installing a solar power plant, a cost calculation is provided (tab. 1)

Table 1 - *Calculation of the cost of installing a solar power plant*

Name	Units of measurement	Quantity	Costs	Expenses
Solar battery SilaSolar 350W PERC (5BB)	Pcs	3	11 100	33 300
Charge controller SRNE RM6	Pcs	3	2 671	8 013
Inverter IS2-12-300G	Pcs	3	3 861	11 583
Leoch DJM-12250 Battery	Pcs	2	34 272	68 544
Cable RKGM 6.0	m	40	84	3 360
"IceFree-O 110-3330" brand cable	m	10	12 715	127 150
Film	roll	37	2 100	77 770
Temperature and precipitation sensor	Pcs	1	14 292	14 292
Total				344 012

This design can generate excess energy, which must be appropriately directed to power active consumers, which can be: light masts, traffic lights, information board.

For comparison, let us calculate the costs of snow removal and sanding of the sidewalk for 1 cleaning (tab. 2).

Table 2 - *Estimated cost for snow removal and sprinkling of footpaths*

Name	Units of measurement	Quantity	Costs	Expenses
Cleaning of sidewalks, rest areas and parking lots from snow and ice: with a mechanical brush on a 40 kW (55 hp) tractor	1000 m^2	1,0844		
Labor costs of drivers	pers.hours	0,15	11,6	1,89
Tractors on pneumatic wheels when working in other types of construction 40 kW (55 hp)	mach.hours	0,15	75,00	12,2

Name	Units of measurement	Quantity	Costs	Expenses
Spreading sand by hand: on sidewalks, public transport stops, recreation areas	1000 m^2	1,0844		
Road worker 2 categories (cf. 2)	pers.hours	2,56	142,7	396,14
Labor costs of drivers	pers.hours	0,32	277,43	96,27
Bobcat S300 loader	mach.hours	0,32	210,5	67,35
Sand	m^3	0,2	280	56
Total				629,85

Based on all of the above, we can conclude that in the modern world, the use of a cable system is environmentally friendly and economical, since the system works on the principle of waste-free production, and the main costs are directed to its purchase. Due to the relatively small cross-section of cables, the design has small dimensions, which allows it to be arranged anywhere. The main feature of the proposed cable system is a heat-reflecting film that minimizes heat loss inside the structure.

This installation works in an autonomous mode, which leads to a reduction in the consumption of energy supplied from solar panels. Solar panels are good because they only require costs for their purchase and installation, taking into account the fact that they pay off during operation. The approximate payback period is 6 years.

References

1. GOST 50597-2017. Automobile roads and streets. Requirements for the operational state permissible under the conditions of ensuring road safety. Control methods (as amended).

2. GOST 33181-2014. Automobile roads for general use. Requirements for the level of winter maintenance.

3. State estimate standards of the RF. GESNs 81-06-01-2001. State elementary estimate standards for the maintenance of public highways and bridge structures on them HESNs-2001. Collection N 1 (recommended for use by the letter of Rosstroy dated May 5, 2008 N VB-1956/02)

4. Well, the weather in Perm [Electronic resource]. – URL: https://perm.nuipogoda.ru/

5. Center for warm floors [Electronic resource]. – URL: https://www.profi-nn.ru/catalog/teplie-stupeni-pandusi-otkritie-ploschadki/kabel-ice-free-o-110-3330

6. Solar-e.ru formula of the sun [Electronic resource]. – URL: https://perm.solar-e.ru/catalog/akb/filter/yemkost_inf20-from-967/apply/

DOI 10.34660/INF.2020.49.18.024

使用蒙特卡洛方法开发一种用于估计接收和发送信号而没有失真的概率的算法

DEVELOPMENT OF AN ALGORITHM FOR ESTIMATING THE PROBABILITY OF RECEIVING AND TRANSMITTING A SIGNAL WITHOUT DISTORTION USING THE MONTE CARLO METHOD

Saidov Behruz Badridinlovich
Postgraduate
South Ural State University,
Chelyabinsk, Russia
Tajik Technical University named after academician M.S. Osimi
Dushanbe, Republic of Tajikistan
Telezhkin Vladimir Fedorovich
Doctor of Technical Sciences, Full Professor
South Ural State University
Chelyabinsk, Russia

抽象。 在本文中，我们研究了应用小波变换理论的可能性，该理论已在解决公司通信系统中创建有效无线（安全）通信领域中的各种问题中得到应用，并提出了一种算法，可以估算 基于统计建模（Monte-Carlo）的不失真的超声波信号传输概率，这使您可以解决存在不确定性因素的情况下的问题。

关键词：小波分析 超声波信号 信号传输与转换； 统计方法; 蒙特卡罗方法； 不确定。

Abstract. *In this paper, we investigate the possibility of applying the theory of wavelet transform, which has found application in solving various problems in the field of creating effective wireless (secure) communication in corporate communication systems and proposes an algorithm that makes it possible to estimate the probability of transmission of ultrasonic signals without distortion based on statistical modeling (Monte -Carlo), which allows you to solve problems in conditions when there is an element of uncertainty.*

Keywords: *wavelet analysis; ultrasonic signals; signal transmission and conversion; statistical methods; Monte Carlo method; uncertainty.*

The statistical modeling method or the Monte Carlo method allows solving problems in which there is an element of uncertainty. Therefore, to determine the

values of a particular quantity on a computer, using a random number generator (sensor) (RNG), situations or processes are simulated that are possible by the condition of the problem, and which lead to certain outcomes (in our case, there is interference or not), when the sought value takes on a certain value. All or almost all of the different outcomes appear if we repeatedly consider the random development of the same initial state (to simulate a certain number of stories - N) [1-5], for example, in our case, there is an obstacle or not. The law of large numbers of "played" stories states that the arithmetic mean of the values of the investigated quantity obtained in each drawing (in our case, there is interference or not) has the limiting sought value (in our problem, therefore, it is 1/2) [6].

This is probabilistic convergence, that is, the more stories (events) there are, the more reliable it can be argued that our result is close to the true one [7]. For problems with elements of uncertainty - and in the real world all tasks are like this - this is even natural. Limit error is proportional to 1 / √N. Thus, to increase the accuracy of the result by one order of magnitude, it is required to play 100 times more stories. It is "reasonable" to initially set the number of stories to be about 10000.

Therefore, it is required to obtain a lot of random numbers so that the transition from one number to another is determined by simple rules, but so that the numbers themselves “give the impression of randomness” (they are therefore called pseudo-random numbers). For example, to select a sequence of random digits, you can take the fractional part of pi ($\pi = 3.141592$ ... The reverse statement is of interest: is it possible that for any finite, predetermined sequence of digits, there is its embedding in the infinite representation of the number π). This method, however, is not very suitable for programming. As a rule, when solving problems by the Monte Carlo method, procedures are used that, using recurrent formulas, generate random numbers uniformly distributed over the interval [0, 1] [8-10].

Modeling game probabilistic situations is very useful for understanding this method. It is the “game” or related to something familiar (known, “everyday”) formulation of the problem that helps to better assimilate the method, to comprehend the concept of probability.

Advantages and disadvantages. Let us analyze the disadvantages and advantages of the numerical method for calculating uncertainty based on the Monte Carlo method.

Benefits:

a) it is possible to evaluate any statistical characteristics of the measurement result Y, and not just the standard deviation;

b) the possibility of step-by-step estimation of uncertainty, when the output of one model serves as the input of another model (any number of such steps is allowed);

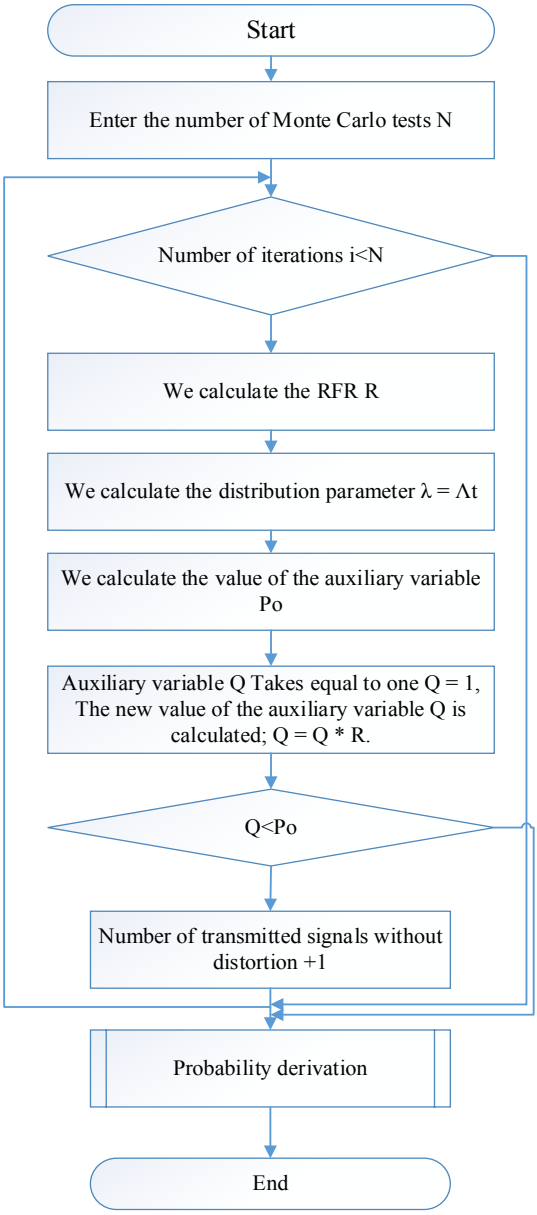


Fig. 1. *Algorithm for estimating the probability of signal transmission without distortion*

c) applicability for any types of mathematical models of measurement results, both linear and nonlinear (it is not necessary to determine the required number of members of the Taylor series to approximate the function f);

d) the uncertainty of the input quantities can be arbitrarily large;

e) there is no need to know or make assumptions about the form of the distribution law of the output quantity Y of the mathematical model of the measurement result;

f) it is not necessary to make any assumptions about the symmetry of the distribution laws, both input and output quantities, or to bring the input quantities to symmetrically distributed;

g) there is no need to evaluate the sensitivity coefficients (partial derivatives of the first order);

i) there is no need to calculate the number of effective degrees of freedom using the Welch-Statesweit formula;

j) the computational complexity is determined by the number M of realizations of the input values and the computation time of the function f.

Disadvantages:

a) it is necessary to have efficient generators of pseudo-random numbers with a long period;

b) complex models can require a lot of computational time for M implementations;

c) the sensitivity coefficients of the mathematical model cannot be obtained;

d) the mathematical model must be numerically stable in connection with the estimation not only in the vicinity of the assigned value, but also on all intervals of all distributions of the input quantities.

Gap analysis:

a) any modern mathematical software packages contain PRNGs with a long period (>> 106);

b) it is not critical when calculating on a PC using mathematical software packages and, especially, using specialized software, for example, "Uncertainty 1.5";

c) the MMK algorithm does not require knowledge of the sensitivity coefficients of the model;

d) this drawback can be considered only if the mathematical measurement model itself was evaluated numerically.

It is required to develop an algorithm and a program for simulating signal transmission based on the Monte Carlo method. Determine the probability of signal transmission without distortion. Since the time intervals between noises are exponential random variables, the amount of noises over a certain time interval t is a random variable distributed according to the Poisson law with the parameter $\lambda = \Lambda t$, where Λ is the intensity of the noise flow. In this example, $\Lambda = 20$ interference / s, or 0.02 interference / ms.

Here is an algorithm for simulating the signal transmission process.

1. Simulation of transmission time (t) is performed. For this, an exponential random variable is played with $\bar{X} = 5$.

2. The amount of interference (m) is played during the signal transmission time t. For this, an algorithm for simulating a Poisson random variable is used, with $\lambda = 0.02t$.

3. If m = 0 (during the transmission of the signal there was no interference), then the signal is not distorted.

4. Steps 1-3 are repeated multiple times (eg 100,000 times). The probability of signal transmission without distortion is calculated as the ratio of the number of signals transmitted

without distortion to the total number of simulated signals (number of tests).

Algorithm for simulating a Poisson random variable: Simulating a Poisson random variable A Poisson random variable is a quantity that takes values m = 0,1, 2, ... with probabilities determined by the following formula:

$$P_m = \lambda^m / m! \cdot e^{-\lambda}$$

where λ is a distribution parameter (i.e. some number).

Thus, a Poisson random variable can take on any non-negative integer values (from zero to infinity). For example, the Poisson distribution law corresponds to the number of events in a Poisson stream [15-20] that occur over a certain time interval t. In this case $\lambda = \Lambda t$, where Λ is the intensity of the flow of events (i.e. the average number of events occurring per unit time).

The following algorithm is used to simulate a Poisson random variable.

1. The value of the simulated quantity is assumed to be zero: m = 0.

2. The value of the auxiliary variable P0 is calculated.

3. Auxiliary variable Q is taken equal to one: Q = 1.

4. The CPRF R is played.

5. The new value of the auxiliary variable Q is calculated: Q = Q • R.

6. If $Q \geq P0$, then the value of the simulated quantity is increased by one (m = m + 1), and returns to step 4. If $Q < P0$, then the algorithm ends. The modeled value of the Poisson random variable is m.

Finally, the probability of signal transmission without interference is calculated as the ratio of the number of signals transmitted without distortion to the total number of simulated signals (number of tests).

The simulation of the signal duration from the RFID was carried out in the MATLAB program. Below is a graph of the dependence of the simulated signal duration on the RFP.

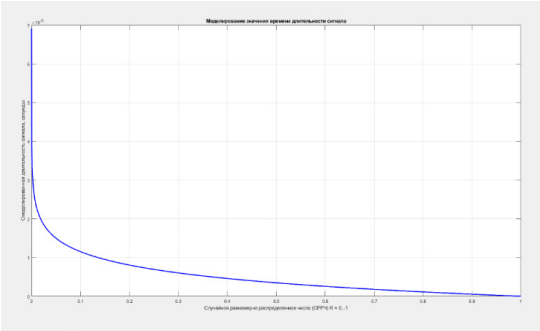


Fig. 2. *Simulation of the duration of the signal from the RFID*

To obtain the results of calculating the probability of signal transmission without interference, the number of Monte Carlo tests is 100,000,000. The resulting probability each time the program was run remained at the level of 0.999..

References

*1. B.B. Saidov, I.S. Slednev and V.I. Tambovtsev, "Transformations of the signal spectrum in an active nonlinear element with a cubic characteristic", Proceedings of the XXV International Scientific and Technical Conference "Radar, Navigation, Communication" (RLNC * 2019). - Voronezh, vol. 6, 2019, pp. 1–6.*

2. V.F. Kravchenko and V.A. Rvachev, "Wavelet systems and their application in signal processing", Foreign radio electronics. no. 4, 1996. pp. 3–20.

3. A.I. Solonina and S.M. Arbuzov, "Digital signal processing. Simulation in MATLAB", SPb .: BHV-Petersburg, 2008. p.816

4. P.A. Morettin, "Wavelets in Statistics", Reviews of The Institute of Mathematics and Statistics of The University of Sao Paulo. vol. 3, no.2, 1997, pp.211-272.

5. K. Amaratunga, and J.R. Williams, "Wavelet based Green's functions approach to 2D PDEs", **Engineering Computations,** *vol. 10, no 4, 1993, pp. 349-367.*

6. B. Basu and V. K. Gupta, "Wavelet-based analysis of the non-stationary response of a slipping foundation", **Journal of Sound and Vibration,** *vol. 222, no 4, 1999. pp.547-563.*

7. N. Yu. Prokopenko, "Optimization methods" [Text]: study. allowance Nizhegor. state architectures. - builds. un-t. - N. Novgorod: NNGASU, 2018. p.118.

8. B.B. Saidov, V.I. Tambovtsev and I.I. Prokopov, "Spectrum Transformation of an Amplitude-Modulated Signal on an Ohmic Nonlinear Element", Bulletin of the South Ural State University. Ser. Computer Technologies, Automatic Control, Radio Electronics, vol. 20, no. 1, 2020, pp. 71–78.

9. Z. Hu and X. A. Wang, "Probabilistic load flow method considering branch outages", IEEE Transactions on power systems. vol. 21, 2006, pp. 507–514.

10. N.N. Pangina and A.A. Panguin, "Statistical Modeling: Monte Carlo Method", Computer tools in education. no. 5, 2002, pp. 30–43.

DOI 10.34660/INF.2020.79.65.025

比较文本原创性以处理窃隐藏技术的系统

COMPARISON OF THE SYSTEMS FOR CHECKING THE ORIGINALITY OF TEXTS TO PROCESS PLAGIARISM HIDING TECHNIQUES

Sharapova Ekaterina Viktorovna
Senior Lecturer
Vladimir State University

抽象。 本文致力于评估文本原创性的系统的质量评估问题。 给出了比较检查系统处理各种隐藏窃方法的能力的结果。 详细讨论了各种系统处理字符替换的功能。 考虑处理重音符号和连字符的可能性。 尽管检查系统成功地消除了窃罪的掩盖方法，但仍远远没有击败它们。 系统有很多工作要做。因此，有必要继续改进用于检查原创性的系统。

关键词：文本； 文字原创性； 替换字符； 口音。

Abstract. *The paper is devoted to the issues of assessing the quality of the systems for checking the originality of texts. The results of comparing the ability of checking systems to handle various methods of hiding plagiarism are given. The capabilities of various systems to handle character substitutions are discussed in detail. Possibilities of processing accents and hyphenation signs are considered. Despite the success of the checking systems for neutralizing the methods of hiding plagiarism, it is still far from defeating them. Systems have a lot to work on. Therefore, it is necessary to continue to improve the systems for checking originality.*

Keywords: *text; text originality; replacing characters; accents.*

Introduction

Since the creation of systems for checking the text originality, the problem of hiding the facts of borrowing texts has arisen. The interest here is quite great - the need for authors, unique texts is huge, and writing them is a laborious thing [1, 2]. Therefore, there is a temptation to borrow ready-made texts.

Over the past decade, many ways to conceal borrowings have appeared, a number of which have gained great popularity [3]. At same time, originality verification systems are also actively developing and are looking for ways to neutralize methods of hiding plagiarism [4, 5]. Thus, there is a constant struggle between

those who try to hide the facts of plagiarism and those who are trying to detect it [6].

The purpose of the work is to assess the capabilities of systems for checking texts for originality to find borrowed fragments and neutralize the applied methods of hiding plagiarism.

Ability to handle plagiarism hiding techniques

A number of experiments were carried out to analyze the ability of checking systems to detect certain methods of hiding plagiarism [9]. On the basis of texts from Wikipedia (that is, obviously unoriginal), a test set was formed, containing various methods of hiding plagiarism - replacing characters, using hyphenation and accents, modifying texts and multiple translations. The results are shown in Tables 1-4. Due to the large number of possible variants of symbol substitutions, the results of the most common variants or typical representatives of substitution groups are given.

As can see, the checking systems are the best at replacing Russian characters with Latin ones. All considered systems were able not only to detect replacements, but also to process them correctly. The Text.ru and Pr-cy.ru/unique/ systems were able to correctly process the replacement of characters with full-width Latin ones, and AntiPlagiarism.NET, Text.Rucont.ru and Exactus.ru found replacements.

Table 1. *Replacing characters.*

System	Numbers	Latin	Fullwidth Latin	Latin small caps	Greek	Armenian	Cherokee
Antiplagiat.ru	-	+	-	+	+	+	-
Text.ru	-	+	+	*	-	-	-
Content-watch.ru	-	+	-	-	-	-	-
Pr-cy.ru/unique/	-	+	+	-	-	-	-
Advego.com/ antiplagiat/	-	+	-	-	*	-	-
Advego Plagiatus 3	-	+	-	-	*	-	-
Etxt.ru	-	+	-	-	-	-	-
AntiPlagiarism. NET	-	+	*	+	*	*	*
Text.Rucont.ru	-	+	*	*	*	*	*
Be1.ru	-	+	-	-	-	-	-
Miralinks.ru	-	+	-	-	-	-	-
Exactus.ru	*	+	*	*	*	*	*

Latin small caps ones were able to detect such systems as Text.ru, Text.Rucont.ru and Exactus.ru, to process - Antiplagiat.ru and AntiPlagiarism.NET. The Antiplagiat.ru system was also able to correctly process Greek and Armenian characters. Advego.com/antiplagiat/, Advego Plagiatus 3, AntiPlagiarism.NET, Text.Rucont.ru and Exactus.ru were able to find a replacement for Greek characters, but they could not neutralize such replacements. Substitutions of symbols of more rare languages - Cherokee, Coptic, Devanagari and others, could be detected, but not processed by AntiPlagiarism.NET, Text.Rucont.ru and Exactus.ru. Oddly enough, only Exactus.ru was able to detect the replacement of symbols with numbers. The failure of other systems can be attributed to the small popularity of replacing characters with the numbers 0 and 3 due to their great difference in appearance from lowercase letters. Capital letters similar to 0 and 3 are quite rare and the effect of such substitutions is small.

Accents processing is performed by originality checking systems in different ways. Latin letters with acute accent were correctly processed by the systems Antiplagiat.ru, Pr-cy.ru/unique/ and Be1.ru, found by Text.ru, AntiPlagiarism.NET, Text.Rucont.ru and Exactus.ru. Some variants of apostrophes were processed by Content-watch.ru, Miralinks.ru and Pr-cy.ru/unique/. The modifier of the letter acute accent was correctly processed by Antiplagiat.ru and Etxt.ru. Combined gravel and acute were processed by Antiplagiat.ru, Etxt.ru, Text.ru and Pr-cy.ru/unique/.

Table 2. *Accents.*

System	Latin letter with acute	Apostrophe (single quote)	Apostrophe	Dash letter modifier	Apostrophe letter modifier	Letter modifier acute accent	Combined gravel (heavy stress)	Combined acute accent (light stress)
Antiplagiat.ru	+	-	-	-	-	+	+	+
Text.ru	*	-	-	*	*	*	+	+
Content-watch.ru	-	+	-	-	-	-	-	-
Pr-cy.ru/unique/	+	-	+	-	-	-	+	+
Advego.com/antiplagiat/	-	-	-	-	-	-	-	-
Advego Plagiatus 3	-	-	-	-	-	-	-	-
Etxt.ru	-	-	-	+	+	+	+	+
AntiPlagiarism.NET	*	-	-	*	*	*	-	-
Text.Rucont.ru	*	-	-	*	*	*	-	-

Be1.ru	+	-	-	-	-	-	-	+
Miralinks.ru	-	+	-	-	-	-	-	-
Exactus.ru	*	*	*	*	*	*	*	*

Some systems have learned to do hyphenation processing. Most often, systems handle soft transfer correctly (Pr-cy.ru/unique/, Advego.com/antiplagiat/, Advego Plagiatus 3, Be1.ru). The Pr-cy.ru/unique/ system also processes the negation sign, the letter modifier, the minus sign and the digital dash. The Etxt.ru system processes the letter modifier minus sign, Coptic lowercase letter dialect-r not and hyphen. The text.ru system also does not process the Coptic lowercase letter in dialect-r.

The Text.Rucont.ru system processes hyphens, and also detects the use of a digital dash and a Coptic lowercase letter dialect-r not. Exactus.ru was able to process the Coptic lowercase letter dialect-r not and detect the use of all other characters. Such a widespread processing of the Coptic lowercase letter dialect-r is probably not explained so much by its popularity to increase originality, as by filtering systems of symbols of non-basic alphabets - the letter is simply cut out of the text and the words cut by it are glued again. The situation with the exclusion of characters of uncommon encodings when checking texts is quite common. Many systems filter characters before processing. When using character replacement, filtering most often results in the replaced character in a rarely used encoding being stripped from the word. In this case, the word with missing characters is most often not found either in the dictionary or in the original text and is considered unique.

Table 3. *Hyphens.*

System	Hyphen minus	Negative sign	Soft hyphen	Minus sign letter modifier	Digital dash	Coptic small letter dialect-r not
Antiplagiat.ru	-	+	-	+	+	+
Text.ru	-	+	+	*	-	-
Content-watch.ru	-	+	-	-	-	-
Pr-cy.ru/unique/	-	+	+	-	-	-
Advego.com/ antiplagiat/	-	+	-	-	*	-
Advego Plagiatus 3	-	+	-	-	*	-
Etxt.ru	-	+	-	-	-	-
AntiPlagiarism.NET	-	+	*	+	*	*
Text.Rucont.ru	-	+	*	*	*	*
Be1.ru	-	+	-	-	-	-
Miralinks.ru	-	+	-	-	-	-
Exactus.ru	*	+	*	*	*	*

All systems coped with texts in which the order of sentences was changed. Changes in the gender of words could not be processed by Pr-cy.ru/unique/, Etxt.ru and Be1.ru. Only Text.Rucont.ru and Exactus.ru were able to process the change in time. The rest of the systems considered this text to be unique. Text.ru, Content-watch.ru, Text.Rucont.ru, Miralinks.ru and Exactus.ru managed to correctly process the word order change. The failure of the rest of the systems can probably be explained by the use of the shingle algorithm, which is sensitive to word permutations [10, 11].

Table 4. *Modifying text.*

System	Word order	Order of sentences	Time	Kind
Antiplagiat.ru	-	+	-	+
Text.ru	+	+	-	+
Content-watch.ru	+	+	-	+
Pr-cy.ru/unique/	-	+	-	-
Advego.com/ antiplagiat/	-	+	-	+
Advego Plagiatus 3	-	+	-	+
Etxt.ru	-	*	-	-
AntiPlagiarism.NET	-	+	-	*
Text.Rucont.ru	+	+	+	+
Be1.ru	-	+	-	-
Miralinks.ru	+	+	-	+
Exactus.ru	+	+	+	+

Conclusion

Character substitutions have a wide variety of combinations. Modern systems can detect and handle the most common substitutions (for example, change Russian characters in Latin) [12, 13]. Nevertheless, many variants of character substitution go unnoticed by the verification systems.

The use of various accents and hyphens is sometimes handled by checking systems. But in most cases, the use of stress and hyphenation marks goes unnoticed and contributes to an increase in the originality of the texts. This is a big disadvantage of existing systems. Changing the order of sentences and the gender of words is most often handled by checking systems correctly. The change in tenses and word order is often left unchanged by checking systems and allow a high score for originality.

Thus, despite the success of the checking systems for neutralizing the methods of concealing borrowings, it is still far from defeating them. Systems have a lot to work on. Therefore, it is necessary to continue to improve the systems for checking originality.

Acknowledgment

The reported study was funded by RFBR according to the research project № 19-07-00692.

References

1. Larkham P., Manns S. Plagiarism and its treatment in Higher Education // J. of Further and Higher Education, 2002, vol. 26, pp. 339-49.

2. Currie P. Staying out of trouble: Apparent plagiarism and academic survival // J. of Second Language Writing, 1998, vol. 7, pp. 1–18.

3. McKeever L. Online Plagiarism Detection Services - Saviour or Scourge? // Assessment & Evaluation in Higher Education, 2006, vol. 31, pp. 155–165.

4. Howard R.M., Davies L.J. Plagiarism in the Internet age // Education Leadership, 2009, vol. 66, pp. 64–67.

5. Zobel J., Hamilton M. Managing student plagiarism in large academic departments // Australian Universities Review, 2002, vol. 45, pp. 23-30.

6. Mozgovoy M., Kakkonen T., Cosma G. Automatic Student Plagiarism Detection: Future Perspectives // J. of Educational Computing Research, 2010, vol. 43, pp. 511-531.

7. Sochenkov I., Zubarev D., Tikhomirov I., Smirnov I., Shelmanov A., Suvorov R., Osipov G. Exactus Like: Plagiarism Detection in Scientific Texts Advances in Information Retrieval // 38th European Conference on IR Research, ECIR 2016, Padua, Italy, pp. 837–840.

8. Sharapova E., Sharapov R. Detection of Fuzzy Text Duplicates in Large Amounts of Information // Proc. XXI International Conference Complex Systems: Control and Modeling Problems (CSCMP), Samara, Russia, 2019, pp. 172-176.

9. Pennycook A. Borrowing others' words: Text, ownership, memory and plagiarism // TESOL Quarterly, 1996, vol. 30, pp. 201-230.

10. Broder A., Glassman S., Manasse M., Zweig G. Syntactic Clustering of the Web // Comput. Netw. ISDN Syst., 1997, vol. 29, pp.1157–66.

11. Sharapova E., Sharapov R. System of fuzzy duplicates detection // Applied Mechanics and Materials, 2014, vol. 490-491, pp. 1503-1507.

12. Le Heron J. Plagiarism, learning dishonesty or just plain cheating: The context and countermeasures in Information Systems teaching // Australian J. of Educational Technology, 2001, vol. 17, pp. 244-264.

13. Martins V., Fonte D., Henriques P., da Cruz D. Plagiarism Detection: A Tool Survey and Comparison // Proc. of the 3rd Symposium on Languages, Applications and Technologies, SLATE 2014, pp. 143–158.

UDC 621. 396: 521. 19
DOI 10.34660/INF.2020.71.31.026

具有调制kharakteristicheskaya函数的信号的Gladdie衰落的信道中调制解调器的研究

STUDY OF A MODEM IN A CHANNEL WITH GLADKIE FADING OF SIGNAL WITH MODULATED KHARAKTERISTICHESKAYA FUNCTION

Veshkurtsev Yury Mikhaylovich
Doctor of Technical Sciences, Dean
Institute of Radio Electronics, Service and Diagnostics

抽象。 考虑了glakyie衰落信号对数字系统的抗干扰性的影响。 调制解调器用于接收信号，其中通过电报消息调制kharakteristicheskaya函数。调制解调器的调制器是已知的，它可以产生幅度偏移键控（ASK）信号，解调器已获得专利，并且可以根据新调制方法（SSK）中开发的算法接收信号。在带有瑞利型信号的Gladkie衰落的信道中，调制解调器在“白”噪声背景下以弱信号稳定工作。 同时，其抗扰性在错误概率为$11 \cdot 10^{-17}$时提高了30 dB。

关键字：通信信道，glankie衰落，调制解调器，kharakteristicheskaya函数，统计调制（SSK），抗扰度，错误概率。

Abstract. *The influence of a gladkie fading signal on the noise immunity of a digital system is considered. The modem is built to receive signals in which the kharakteristicheskaya function is modulated by telegraphic message. The modulator of the modem is well- known and it generates an amplitude-shift keying (ASK) signal, the same time a demodulator is patented and receives signals according to an algorithm developed in the new modulation method (SSK). In a channel with gladkie fading of a Rayleigh-type signal, the modem works stably with weak signals against a background of "white" noise. At the same time, its noise immunity increases by 30 dB at the level of error probability 1·10^(-17).*

Keywords: *communication channel, gladkie fading, modem, kharakteristicheskaya function, statistical modulation (SSK), noise immunity, error probability.*

The terminology of a well-known author is used in the title of the article and in the article [1]. A signal with amplitude shift keying (ASK) is considered in relative to the substantiation of a new modulation method SSK (statistical shift keying). The beginning of the SSK description was published in [2]. There is also

a diagram of the demodulator, but the modem modulator remains classic. Nevertheless, the signal at the output of the modulator needs explanation. The point is that the signal of any physical source of oscillations has a random phase instability [3]. According to the rules of statistical radio engineering, such an oscillation can be called a quasi-deterministic signal with probabilistic characteristics, we single out the kharakteristicheskaya function from them. According to relevant studies, the signal at the output of the modulator contains an abrupt change not only in the amplitude, but also in the kharakteristicheskaya function. Therefore, we can consider SSK along with ASK here. An analysis of the SSK noise immunity was carried out earlier in a fading-free channel when there is fluctuation noise such as "white" noise [2]. The article considers the study of the modem continued in the channel with gladkie fading.

Basic relationships. A signal model with amplitude shift keying is represented by the expression

$$u(t) = [a \times s(t)]\sin(\omega t + \eta),, \quad (1)$$

where a - constant amplitude; η - random initial phase with uniform distribution law on the interval 0..2π; $s(t)$ telegraph signal in the form of a sequence of logical "0" and logical "1"; ω - constant frequency. The probabilistic characteristics of the signal (1) are known, in particular, its instantaneous values are distributed according to the arcsine law, and the kharakteristicheskaya function (k.f.) is equal to

$$\Theta(V_m, t) = m_1\{\exp[jV_m u(t)]\} = m_1\{\cos[V_m u(t)]\} + jm_1\{\sin[V_m u(t)]\} = J_0(V_m a \times s(t)), \quad (2)$$

The probabilistic characteristics of the signal (2) have changed in comparison where $m_1\{\cdot\}$ – mathematical expectation operator; V_m – parameter of k.f.; $J_0(\cdot)$ – zero-order Bessel function of the first kind. Assume a = 1,5, $V_m = 1$. When $s(t) = 0$, then $J_0(0) = 1$. If $s(t) = 1$, then $J_0(1{,}5) = 0{,}5$. K.f. changes abruptly in time with changes in the telegraph signal, and reaches a maximum when transmitting a logical "0".

Signal (1) is converted many times on its way from transmitter to receiver. Repeating verbatim all signal transformations (1) in the multipath communication channel, recorded in the book [1], we obtain at the value $s(t) = 1$

$$u_\Sigma(t) = \mu \sum_{i=1}^{k} \grave{a} \sin(\omega t + \eta_i + \phi_i), \quad (2)$$

and $u_\Sigma(t) = 0$ at $s(t) = 0$, where μ – communication channel transmission coefficient (random variable); ϕ_i – random phase shift; k – the number of rays of propagation of radio waves in the communication channel.

with the oscillation (1). The amplitude of the signal (2), taking into account the coefficient μ is distributed according to the Rayleigh law, and the random phase

is distributed according to the uniform law. Then the instantaneous values of the signal (2) will be distributed according to the normal law. The author [1] calls such fading signals common or gladkie and uses the term Rayleigh fading if the time delay between the propagation beams of radio waves $\tau_p >> 2\pi/\omega$. When $\tau_p << 2\pi/\omega$, then it is proposed to call such fading quasi-Rayleigh or Rice fading.

From the receiver to the input of the demodulator, the circuit of which is described in [2] and in the updated version is shown in Fig. 1, an additive mixture is supplied

$$z(t) = u_{\Sigma}(t) + n(t), , \tag{3}$$

where $n(t) -$ fluctuation noise of the "white" noise type. Recall that the demodulator measures the estimate k.f. by algorithm

$$\hat{A}(V_m, t) = \frac{1}{N}\sum_{k=1}^{N} \cos\left[V_m z(k\Delta t)\right], , \tag{4}$$

where $z(k\Delta t) -$ discrete instantaneous values of the additive mixture (3); $\Delta t -$ sampling interval; $N -$ sample size of discrete values.

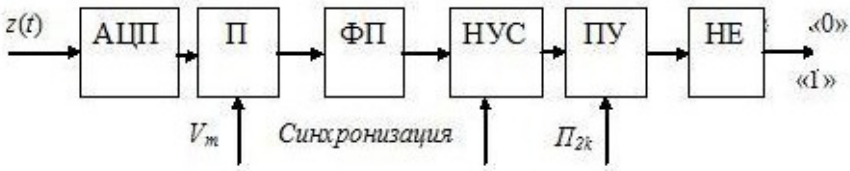


Fig. 1. *Demodulator: ADC – analog – digital converter; M – multiplier; FC – functional cosine converter; AAA – accumulating averaging adder; TD – threshold device; IV – inverter*

Estimate (4) is a random variable, the most probable (exact) value of which at $s(t) = 1$ equals

$$A(V_m, t) = m_1\{\cos V_m z(t)\} = \int_{-\infty}^{\infty} \cos(V_m z) W(z) dz = \exp\left[-\frac{1}{2} V_m^2 \mu_0^2 \sigma_c^2 \left(1 + h^2\right)\right], \tag{5}$$

where $W(z) -$ the probability density of the additive mixture (3); σ_c^2 dispersion (average power) of the signal (1); $h^2 = \sigma_з^2 / \sigma_ш^2$ signal-to-noise ratio in a fading channel; $\sigma_з^2 = \mu_0^2 \sigma_c^2$ signal variance (2); $\mu_0^2 -$ average value of the squared channel gain; $\sigma_ш^2$ variance (average power) of noise. When the value of the telegraph signal is $s(t) = 0$, then expression (5) takes the form

$$A(V_m, t) = \exp\left(-\frac{V_m^2 \mu_0^2 \sigma_{\tilde{n}}^2}{2h^2} \right). \quad (6)$$

Calculation data by formulas (5.6) with parameter $V_m = 1$, variance $\sigma_c^2 = 1{,}125$ are presented in tab. 1.

Table 1. *Exact values of kharakteristicheskaya function*

$A(1,t)$	$s(t)=1$	$\mu_0 = 0{,}8$	0,6977	0,6949	0,6491	0,4868	0,019	0
		$\mu_0 = 0{,}5$	0,8694	0,8676	0,8564	0,7558	0,2122	0
		$\mu_0 = 0{,}1$	1,0	0,995	0,994	0,99	0,9418	0,7558
	$s(t)=0$	$\mu_0 = 0{,}8$	0	0	0,027	0,6977	0,96	1,0
		$\mu_0 = 0{,}5$	0	0	0,2466	0,8694	0,99	1,0
		$\mu_0 = 0{,}1$	0,0037	0,5712	0,9418	0,995	1,0	1,0
h^2			0,001	0,01	0,1	1,0	10	100

Analysis of the noise immunity of the modem. The calculation of the probabilities of modem errors will be done by a method developed on the basis of the statistical theory of decision-making using new elements and initial data. The new element is the real part of k.f., and the initial data are the values of the estimate (4). The estimate is a random variable, depends on the signal-to-noise ratio and has the variance σ_A^2 of the real part k.f. Values of estimate (4) are distributed according to the Gauss law. in which the values recorded in tab. 1 are the most probable, i.e., mathematical expectations. For clarity, fig. 2 shows the distribution law and the initial data, where $W(A)$ – the probability density of the estimate k.f.; $m_L\{A\}$ – expected value of the estimate k.f. There you can also see the interval $L_A = \left| m_1\{A\} - \Pi_{2k} \right|$ between the mathematical expectation of the estimate and the threshold in the demodulator. In fig. 2, the thresholds are shown to the left and right of the mathematical expectation. This is done because when determining logical "0" and logical "1", either the left or the right half of the distribution law is involved. According to the research results described in [4], the variance is equal to $\sigma_A^2 = 10^{-4}$.

Let's start calculating the error probabilities in the demodulator when receiving a logical "0". The mathematical expectation of the estimate is equal to the value (6). All values of the estimate (4) must exceed the threshold $П_{2k}$, shown in fig. 2 on the left. Let's use the three sigma rule. We define the number of sigma using the ratio L_A / σ_A. The probability of errors when receiving a logical "0" is equal to the area under the curve *W(A)*, lying to the left of the threshold $П_{2k}$.

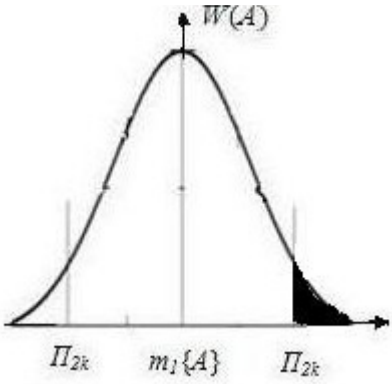


Fig. 1. *Probability density of the real part of kharakteristicheskaya function*

Numerically, it is equal to

$$P_0 = \frac{1}{2}\left[1 - erf\left(\frac{L_A}{\sigma_A}\right)\right] = \frac{1}{2} erfc\left(\frac{L_A}{\sigma_A}\right), , \quad (7)$$

where *erf* (·), *erfc* (·) – integral of probability (error function). Formula (7) is suitable for calculating errors in the demodulator when receiving a logical "1". Only the mathematical expectation of the estimate in this case is equal to the value (5), and the error probability is equal to the area under the curve *W(A)*, lying to the right of the Π_{2k} threshold (colored black), and will be denoted by P_1. Then $P = 1/2\left(P_0 + P_1\right)$ modem error probability. When calculating the error probability by formula (7), instead of $m_1\{A\}$ the data from tab. 1 and $\Pi_{2k} = 0{,}55$ are substituted. The threshold is equal to the number calculated earlier in [2]. The calculation results are presented in tab. 2.

Table 2. *Modem error probability*

P	No fading in the channel	0,5	0,5	0,5	$2{,}5\cdot10^{-3}$	$1{,}1\cdot10^{-17}$	$7{,}5\cdot10^{-9}$
	$\mu_0 = 0{,}8$	$1\cdot10^{-45}$	$1\cdot10^{-45}$	$5{,}6\cdot10^{-44}$	0,5	0,5	0,5
	$\mu_0 = 0{,}5$	$1\cdot10^{-45}$	$1\cdot10^{-45}$	$1\cdot10^{-45}$	0,5	0,5	0,5
	$\mu_0 = 0{,}1$	$1\cdot10^{-45}$	$9{,}3\cdot10^{-4}$	0,5	0,5	0,5	0,5
h^2		0,001	0,01	0,1	1,0	10	100

Figure 3 shows graphically the dependence of the error probability on the signal-to-noise ratio in different communication channels. Curve 2 is borrowed from work 2 and was obtained by analyzing the noise immunity of the modem under study in a channel without fading. Curves 3,4,5 are plotted according to the data from tab. 2 for a channel with Rayleigh fading, and μ_0 = 0,8 for curve 4, μ_0 = 0,5 for curve 3 and μ_0 = 0,1 for curve 5. Curves 3,4,5 are rotated 180^0 relative to curve 2 at a point with an abscissa $h^2 = 1$. It turns out that the channel with fading has a positive effect on the noise immunity of the modem under study, increasing it by at least 30 dB at the error probability level of $1 \cdot 10^{-17}$. In our opinion, this is achieved due to the amazing properties of SSK modulation, or rather, thanks to the kharakteristicheskaya function and dynamic chaos. The fact is that the quasi-deterministic signal (1) has an inverse sine distribution law and moderate dynamic chaos in the channel without fading. Signal (1) in a fading channel is converted into signal (2) with a normal distribution and maximum dynamic chaos. In SSK modulation, dynamic chaos increases the noise immunity of the modem [5]. In turn, the kharakteristicheskaya function perfectly fights noise, it suppresses "white" noise by 5000 times or more at a ratio of $h^2 << 1$ [6]. Due to this, the investigated modem can operate in a channel with Rayleigh or Rice fading with very weak signals and error probabilities at the level of $1 \cdot 10^{-30}$.

Let's pay attention to the movement to the left of curves 3,4,5 depending on the value of the coefficient μ, which has the Rayleigh distribution. The Rayleigh law graph has a maximum at $y = x/\mu_0 = 1$, where $x -$ current value of the signal amplitude (2). When decreasing μ_0 the abscissa y of the graph of Rayleigh law is arbitrarily close to $y = 0$ and, thus, Rayleigh law with an entropy of 0.56 is transformed into an exponential one-sided (exponential) law with an entropy of 0.43. At the same time, signal strength decreases and dynamic chaos decreases. This negatively affects the noise immunity of the modem, because at the $\mu_0 \le 0{,}01$ value the graph in fig. 3 runs parallel to the abscissa axis at the error probability level of 0.5.

For comparison, fig. 3 curve 1 is plotted according to the author's data [1, p. 351]. It shows the error rate for ASK modulation with deterministic signal without dynamic chaos for Rayleigh fading in the channel. You can clearly see how the classic ASK modulation loses to the new SSK modulation. Thus, SSK modulation is the future today.

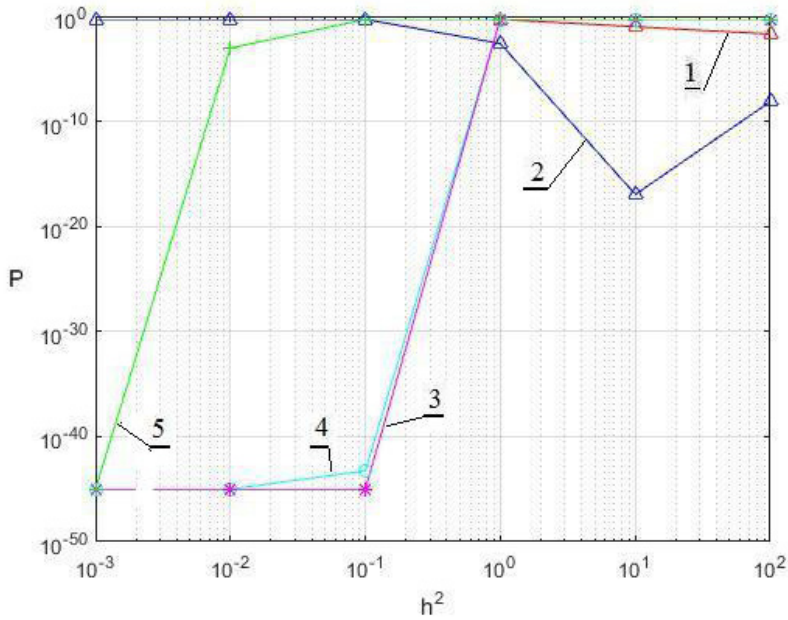


***Fig. 3**. Probability of modem errors for receiving a signal with SSK modulation*

Conclusion

The study of a modem for receiving signals with modulation of kharakteristicheskaya function in a channel with Rayleigh fading against the background of fluctuation interference such as "white" noise proved that this device works stably with weak signals and has good performance. The modem noise immunity has increased by 30 dB at the error probability level of 1·10^(-17) compared to its own indicators in the fading –free channel. Kharakteristicheskaya function and dynamic chaos give positive qualities to the new modulation method. Therefore, we can confirm that SSK modulations is our future today.

References

1. Fink LM Theory of transmission of discrete messages. Ed. 2, revised and supplemented. Moscow: Sov. Radio, 1970. 728 P.

2. Veshkurtsev Yu.M. Increasing the noise immunity of the modem of digital systems with amplitude shift keying // Devices and Systems. Management, control, diagnostics, 2019. № 7. P. 38 – 44. DOI:10.25791/pribor.07.2019.741

3. Veshkurtsev Yu.M. Formation of the reference oscillation in the statistical analysis of phase fluctuations // Instruments and experimental techniques, 1977. № 3. P. 7 – 13.

4. Veshkurtsev Yu. M. Fundamentals of the theory of construction of new generation modems. Novosibirsk: publishing house "OOO SibAK", 2020. 184 P.

5. Gulyaev Yu.V., Belyaev R.V., Vorontsov G.N., Zologin V.I., Kalinin V.I., Kalyanov E.E., Kislov V.V., Kislov V.Ya., Kolesov V V., Myasin E.A., Chigin E.P. Information technologies based on dynamic chaos for the transmission, processing, storage and protection of information // Radioelectronics. Nanosystems. Information Technology, 2018, V.10, № 2, P. 279 – 312.

6. Veshkurtsev Yu. M., Veshkurtsev N.D., Titov D.A. Filtration in the probability space of an additive mixture of an uncentered quasi-deterministic signal and noise // Devices and Systems. Management, control, diagnostics, 2018, № 3, P. 18 – 23.

DOI 10.34660/INF.2020.32.23.027

对哈勃定律的解释
TO INTERPRETATION OF HUBBLE LAW

Ikhlov Boris Lazarevitch
Lead Research Engineer
Special construct bureau "Lighthouse" in Perm State University

抽象。 结果表明，哈勃常数对时间的依赖性应比以前假定的具有更复杂的特征。 考虑到空间的曲率会导致哈勃定律的变化，并会违反空间的同质性。 结果表明，哈勃定律不依赖于拓扑结构和空间尺寸，但是，在很远的距离上并且考虑到SRT的影响，它应该取决于距离。 考虑了银河系速度超过光速的情况。

关键词：密度，超光速，欧拉特性，宇宙均匀性

Abstract. *It is shown that the dependence of the Hubble constant on time should have a more complex character than was previously assumed. Taking into account the curvature of space leads to a change in the Hubble law and to a violation of the homogeneity of space. It is shown that Hubble's law does not depend on the topology and on the dimension of space, however, at large distances and in view of the effects of SRT, it should depend on the distance. The case of galaxy velocities exceeding the speed of light is considered.*

Keywords: *density, superluminal speed, Euler characteristic, uniformity of the Universe*

Introduction

In the theory of the stationary Universe by F. Hoyle, T. Gold, G. Bondi and others (1948), according to which, as the Universe expands, new matter is constantly created between the expanding galaxies. Unlike the theory of Hoyle et al., This model does not claim to be an alternative to the Big Bang version. But if this theory were true, the uniformity of the universe would have to be violated.

The expansion of the universe is significantly different from the expansion of a gas into a void when pressure is maintained. An analogue of the uniform expansion of the Universe can be the expansion of a sphere upon heating, which consists of many crystals: with the energy of interparticle interaction of the van der Waals type $U \sim r^{-6}$, with the Madelung energy in ionic crystals $U_{ij} = c_1 \exp(-c_2 r_{ij}) \pm q^2 / r_{ij}$ with empirical constants, covalent, metallic or with hydrogen bonds - with weak,

slow and uniform heating. Or, for example, a heated raisin pudding model, locally all the raisins are removed from each other.

But such models 1) cannot be formed from the material of the early Universe, 2) do not correspond to the binding energy in the Universe and its cooling, 3) contradict Hubble's law.

According to one of the interpretations, the speeds of the recession of galaxies are not related to the usual speeds, but, like the redshift, are a manifestation of the expansion of space. According to the same interpretation, the Doppler effect is not related to redshift. However, this contradicts not only the history of the discovery of the redshift, but also the formal logic.

When the Universe expands, connected or close objects do not scatter, their mutual attraction overpowers the expansion. That is, the source of runaway is quite comparable to mechanical force.

If the recession of galaxies is an expansion of space, then the rulers used for measurements also expand. Therefore, the expansion of the universe should not be observable. Secondly, if the space of connected objects does not expand, and the space between star clusters expands, this would mean a difference in the structure of space at small and large distances and would lead to the appearance of stresses inside the connected objects.

It can be assumed that Hubble's law, like the cosmological principle, is fulfilled approximately. Deviations from Hubble's law are peculiar motions of galaxies associated with deviations from homogeneity and isotropy due to the existence of groups, clusters and superclusters of galaxies. However, the peculiar velocities of galaxies and their clusters are practically independent of the distance, while the Hubble velocity *Hr* increases with distance, therefore the relative contribution of peculiar velocities to the motion picture of objects in the distant Universe is relatively small.

But, as A. Sandage pointed out, Hubble's law operates even inside the inhomogeneity cell, at distances of about 2 Mpc, while the transition to the uniformity of the Universe occurs at distances 150 times larger. This means that the stage of the Universe, dusty or radiation domination, cannot play a role, since inhomogeneities do not affect the Hubble constant.

Nevertheless, the expansion is substantially non-uniform, similar to certain phase transitions. Depending on the equation of state of matter at the inflation stage, the Hubble constant $H = \sqrt{8\pi\rho_{vac} / 3m_{pl}^2}$, in the stage of radiation dominance ($p = \rho c^2 / 3$) $H = 1/2t$,in dusty stage ($p = 0$) $H = 2/3t$, in the stage of Λ - dominance $H = \sqrt{8\pi G\rho_{\Lambda} / 3}$.

We point out that in a continuous medium, phase transitions with a change in temperature lead to a change in density. References to dark energy, which should

determine the dynamics already at distances of 1.5-2 Mpc and is distributed with a much greater degree of homogeneity than ordinary matter, do not pass, since in this case phase transitions would not take place.

With isotropic expansion, H is a spatial constant. The time dependence of H is determined by additional conditions. If each object of the expanding structure moves at a constant speed, then $H = H(t)$ is a decreasing hyperbolic function: $H = const/t = a/t$. Otherwise, it is easy to show that instead of the Hubble law with an exponential time dependence of distance, the following relations will occur: $v \sim at^{a-1} \sim r^{1-1/a}$.

This means that in the stage of radiation dominance and in the dusty stage, the expansion proceeded at a constant rate. However, for example, for the dust stage $a(t) \sim t^{2/3}$.

Hubble's law corresponds to the cosmological principle only for non-relativistic velocities. Let v_1 and r_1 - be the vectors of the velocity of removal and distance from the Earth of some arbitrarily chosen galaxy 1. The same quantities measured in the reference frame associated with galaxy 2 will be denoted by v_1' and r_1'. Let us denote v_2 - the velocity vector of galaxy 2, r_2 - its radius vector relative to our galaxy. The vectors of velocities and distances are related by the Galilean transformations: $v_1 = v_1' + v_2; r_1 = r_1' + r_2$. According to Hubble's law, $v_1 = Hr_1; v_2 = Hr_2; v_1 - v_2 = H(r_1 - r_2)$, then $v_1' = Hr_1'$. Obviously, at relativistic velocities, Hubble's law contradicts the homogeneity and isotropy of the universe.

In the Friedman model, the Hubble constant $H = \dot{a}/a$ depends on time ($a(t)$ – scale factor). For not too distant objects, the redshift $z = Hr$ [1], respectively, Hubble's law $v = Hr$. That is, for remote objects, the connection should have a different form.

The generalized Hubble's law in the relational approach with pregeometry [2] does not answer these questions.

Superluminal speeds

In [3] in the last chapter, the light cone is considered, integrating the interval, the SRT equation is obtained (ibid, f. 114.2), homogeneity is also considered as the sameness of metric properties at all points of space (ibid, p. 482). However, superluminal speeds are not considered.

According to some interpretations of the expansion of the Universe, "the apparent superluminal expansion of the horizon of the particles of the Universe does not contradict the theory of relativity, since this speed cannot be used for superluminal information transmission and is not the speed of movement in the inertial frame of reference of any observer" [4].

Nevertheless, it is generally accepted that the speed of distant galaxies may well exceed the speed of light, and this does not contradict the special theory of relativity (SRT).

There is an explanation of this kind: at such huge distances, the meaning of the concept of "speed" is lost.

One way or another, reaching and exceeding the speed of light by distant galaxies, according to the generally accepted opinion, does not lead to a divergence in energy of the type $T = mc^2 / \sqrt{1 - v^2 / c^2}$.

Exceeding the speed of light during the expansion of the Universe is not the only one, in thin slits of 1 nm the speed of light in the Casimir vacuum, according to the theoretical calculations of K. Scharnhorst, is 10^{-24} higher than the speed of light in an ordinary vacuum, and this does not lead to a violation of causality [5].

There is a statement that you can see galaxies scattering from us at a speed greater than the speed of light – "because the expansion rate changes with time. First, the photon is actually blown away by the expansion. However, the Hubble distance is not constant: it increases, and, eventually, the photon can enter the Hubble sphere. Once this happens, the photon will move faster than the Earth is moving away, and it can reach the Earth [6].

It is indicated that within the framework of the standard cosmological model, galaxies with a redshift of about 1.5 (i.e., the received wavelength of their radiation is 50% greater than the laboratory value) are moving away at the speed of light, about 1000 galaxies with redshifts greater than 1.5 have been found. I.e. receding faster than the speed of light. The relic radiation comes from an even greater distance and has a redshift of about 1000. When the hot plasma of the young Universe emitted the radiation we receive today, it was moving away from us almost 50 times faster than the speed of light (ibid.).

There is an opposite statement that in the future we “will no longer be able to see as many galaxies as now, because they will fly away from us faster than the speed of light (due to the expansion of space), so their light cannot reach us” [7].

However, both statements are incorrect, just look at the relativistic law of velocity transformation: $v = (v_1 + v_2) / (1 + v_1 v_2 / c^2)$.

If the speed of the photon is c, and the speed of the runaway galaxy is also c, then the sum of the speeds will still be c. Electromagnetic radiation “doesn't care” at what speed a galaxy moves, with subluminal or superluminal speed - the speed of light does not depend on the speed of the light source, the light of distant galaxies must move in the direction of our galaxy at the speed of light, not at all reduced by the speed of a distant galaxy.

On the other hand, consider the expression for the frequency for the relativistic Doppler effect:

$$\omega = \omega_0 \sqrt{\frac{1 - v/c}{1 + v/c}}$$

When the galaxy reaches the speed of light, the electromagnetic disturbance will cease to have a wave nature. Under $v > c$ the frequency becomes imaginary, therefore, the amplitudes of the electromagnetic disturbances will decay exponentially without oscillations: $A \sim e^{-\beta t}$, where $\beta = \omega_0 \sqrt{v/c - 1} / \sqrt{v/c + 1}$.

That is: at the light boundary, signals from distant galaxies will cease to arrive.

But this does not mean at all that superluminal galaxies stop interacting with our galaxy. Since they interact with distant sub-light galaxies, and they, in turn, interact with our galaxy (gravitational non-wave or electrostatic interactions are in question). If there were a device that transmits information from the superluminal galaxy to our galaxy through the subluminal galaxy, we could receive superluminal electromagnetic signals, but traveling at the speed of light. Similarly, one can observe through the telescope the rattling of glass in the windows of houses excited by the explosion, without seeing or hearing the explosion itself.

A natural candidate for such phenomena can be the hydrogen lines of subluminal hydrogen clouds observed for 2-3 weeks or the O, N, S lines, excited by radiation in superluminal supernova explosions invisible to us.

How relevant is the question? Let's estimate the speed of the most distant galaxies. As of January 2013, an object with a maximum redshift of approximately 11.9 was considered to be the protogalaxy UDFj-39546284.

In 2015, astrophysicists at the Keck Observatory in Hawaii recorded radiation from the galaxy EGSY8p7, the farthest galaxy from Earth. It is located at a distance of 13.1 billion light years. We see it as it was 585 million after the Big Bang. Its speed is sublight.

At very large distances, when the velocities of galaxies begin to play a role, the curvature of space-time, nonstationarity, in general, the determination of such distances depends on the adopted model of the Universe. Therefore, the speeds are usually estimated by the redshift coefficient *z*:

$$v = c \frac{(1+z)^2 - 1}{(1+z)^2 + 1}$$

But the presence of superluminal galaxies can also be estimated by the radius of the Universe. There are estimates at 78 billion light years, we will use the better known one - 46 billion light years [5]. Substituting this value and the current value of the Hubble constant $H = 2{,}2 \cdot 10^{-18}$ into the Hubble law $v = Hr$, we get the speed $v = 0{,}96 \cdot 10^9$, which is almost three times the speed of light.

Deviations from Hubble's Law

According to the cosmological principle, any observer at the same time, regardless of the place and direction of observation, discovers the same picture in

the Universe on average. It is argued that independence from the place of observation, that is, the equality of all points in space, is the homogeneity of the universe.

However, homogeneity is something else. If any observer at different points observes the same inhomogeneous Universe, this is not homogeneity. The cosmological principle is a non-trivial statement about the equality of different frames of reference, which deprives the Universe of boundaries. Homogeneity is the same density at different points in the observable Universe.

Hubble's Law does not contradict the cosmological principle. This is illustrated as follows: some geometric figure is considered, formed by several galaxies. Over time, this figure should increase so that it always remains similar to itself. Otherwise, distances in one direction would grow faster than in the other, which would contradict the isotropy of the universe. Therefore, for the same time, the distance to each galaxy must increase by the same number of times.

Consider a one-dimensional case. Let galaxy 1 be located k times farther from our galaxy than galaxy 2. Therefore, 1 should move k times faster than 2. That is, the speed of the galaxy should be proportional to the distance to it, and this is Hubble's law.

If the Casimir effect depends on the shape of the volume, on topology, on the dimension of the space [8], then the expansion according to the Hubble law does not depend on the topology. It is fulfilled both in the model of the Universe in the form of a torus and in the form of a dodecahedron. And, acordingly, in the cube model as well.

The ball is homeomorphic to a cube, its Euler characteristic is equal to the Euler characteristic of the cube $c = 1 + 1 = 2$. But you can imagine a cube only as a graph, without edges. The sphere, on the other hand, has no vertices or edges. We represent polyhedra as graphs and write out their Euler characteristics as the number of vertices increases. Tetrahedron: $c = 4 - 6 = -2$; pentahedron: 5 – 8 or 6 – 9 = - 3; cube (hexahedron): 8 – 12 = - 4; octahedron: 6 – 12 = - 6; dodecahedron: 20 – 30 = - 10; icosahedron: 12 – 30 = - 18.

Since for the Euclidean sphere there are only 5 partitions into regular polygons, we continue to increase the number of vertices on the Lobachevsky plane, the number of partitions for which is an infinite countable set. Then, with an infinite increase in the number of vertices, the polyhedron formed by them goes over into a sphere, and the Euler characteristic of the bordering graph tends to minus infinity.

We see that the expansion models of the Universe can be compared in terms of graphs. At the same time, in order for the Universe to be homogeneous, the graphs bordering the expanding volume of the Universe may have a different Euler characteristic.

For example, let us imagine not a line with several galaxies, but several rows

of galaxies lined up on an area with an interval of 1 ps. Let us move the rows along the *x* axis in one year so that this interval increases to 2 ps. The relative velocity of two adjacent rows of galaxies will be equal to 1 ps/yr, and the relative velocity of two galaxies standing at a distance of 100 ps will be 100 ps/yr, if we take into account that the distance between them will increase from 100 to 200 ps. The increase in the interval along the *y* axis is performed in the same way. Then the speed of mutual removal is proportional to the distance, which corresponds to the Hubble's law, after the expansion of the series, the cosmological principle remains valid: galaxies are still uniformly distributed, and the same proportions between different mutual distances remain. The same will be true for extension along the *z* axis. This kind of expansion takes place when the cube expands.

Hubble's law does not depend on the dimension of space either. The same as in the one-dimensional case will be true for the surface density of the substance during expansion of both the two-dimensional circle and for the bulk density during the expansion of the three-dimensional sphere.

Let's select a point in the Universe and two spheres around it, radius *R* and *2R*. Since the universe is homogeneous, the surface density of, say, stars on these sphere is the same: $\mathrm{r}_1 = m_1 / S_1$, $\mathrm{r}_2 = m_2 / \mathrm{S}_2$ and $\mathrm{r}_1 = \mathrm{r}_2$.

In time *t*, the stars on the first sphere will reach the second sphere due to the expansion of the Universe. Their surface density, respectively, will decrease by 4 times. Since the linear density remains the same, during the same time the stars of the second sphere will reach the sphere of radius 4*R*. Accordingly, their density will also decrease by 4 times.

The same can be done with the bulk density of, say, a thin layer on the surface of a sphere, the volume of which is equal to the difference between the volumes of two cones with close radii:

$$V = \frac{2}{3}\pi R_2^2 h - \frac{2}{3}\pi R_1^2 h = \frac{2}{3}\pi(1-\cos\alpha)(R_2^3 - R_1^3) = f(R_2^3 - R_1^3) \qquad (1)$$

where $f = \frac{2}{3}\mathrm{p}(1-\cos\mathrm{a})$, *h* – the difference between the radius of the sphere and the height of the cone, a - flat angle of the cone. The volume of the layer near a sphere of smaller radius, respectively $V_0 = f(r_2^3 - r_1^3)$. As we agreed, $R_2 = 2r_2$, up to negligible values in view of our approximation $R_2 - R_1 \ll R_2, R_1$ and $r_2 - r_1 \ll r_2, r_1$ we can assume that $R_1 \approx 2r_1$, consequently, $V = 8V_0$. After time *t*, stars from the first volume will occupy the second volume, their density will decrease by 8 times, the density of stars of the second volume will also decrease by 8 times. For a more accurate calculation, you can use Hubble's law again and expand the exponent in a series, leaving the first two terms of $R \sim 1 + Ht$, but the calculations remain the same. This means that the Hubble Law for volumes corresponds to the uniformity of the Universe.

However, since expression (1) contains an angle that changes with radius in non-Euclidean geometry, it is obvious that the curvature of space must violate the uniformity of the Universe, and accordingly, in order to maintain uniformity, it is necessary to change the Hubble law.

In addition, in the SRT, there is an additional multiplier for expressing the radius, which will increase the radius as you move away from the origin:

$$R' = (R - vt) / \sqrt{1^2 - v^2 / c^2}\,,\ t' = [t - (v / c^2)\,\mathrm{R}] / \sqrt{1 - v^2 / c^2}$$

Thus, the observed density should decrease with distance. Since this is not observed, it must be assumed that in view of the SRT, the Hubble constant should depend on the distance.

Conclusion

From the latest astronomical observations, according to which 5 billion years ago the expansion of the Universe accelerated. Thus, after a large-scale decrease in the Hubble coefficient at the end of inflation, this coefficient remains dependent on time. It follows from the above that in order to resolve the issues arising due to the large remoteness of scattering objects in the Universe, due to SRT effects, it is necessary to accept that the Hubble "constant" also depends on the distance.

References

1. Gorbunov D.S., Rubakov D.A. Introduction to the theory of the early universe. M.: LKI,2008. 552 P.

2. Vladimirov Yu.S., Molchanov A.B. Generalized Hubble's Law in the Relational Approach. Space, time and fundamental interactions. 2017. Iss. 2. P. 24-34.

https://readera.org/obobshhennyj-zakon-habbla-v-reljacionnom-podhode-14266196

3. Landau L.D., Lifshits E.M. Field theory.

4. Davis Tamara M., Lineweaver Charles H. Expanding Confusion: Common Misconceptions of Cosmological Horizons and the Superluminal Expansion of the Universe // Publications of the Astronomical Society of Australia. 2004. V. 21. P. 97-109. ISSN 1323-3580. DOI:10.1071/AS03040. arXiv:astro-ph/0310808).

5. Liberati S., Sonego S., Visser M., Faster-than-c signals, special relativity and causality. https://arxiv.org/pdf/gr-qc/0107091.pdf

6. Big Bang paradoxes http://www.modcos.com/articles.php?id=99.

7. This is the opinion of Neil Cornish, an astrophysicist at Montana State University, http://www.zabaznov.ru/statyi/nauka/spacecom.html

8. Mostepanenko V.M., Trunov N. Ya. Casimir effect and its applications. UFN. 1988 November Volume 156, Iss. 3. P. 385-426.

DOI 10.34660/INF.2020.49.37.028

使用计算机视觉系统进行变形和位移的光学计量
USE OF COMPUTER VISION SYSTEMS FOR OPTICAL METROLOGY OF DEFORMATIONS AND DISPLACEMENTS

Plykina Ekaterina Victorovna
Engineer
Tula State University

抽象。 本文讨论了一种使用机器视觉技术测量物体变形的非接触方法，该方法可以消除接触方法的弊端，并降低实验准备的复杂性，并最大程度地减少所需的数学运算次数 计算变形的绝对值。

关键字：机器视觉，应变测量。

Abstract. *The article discusses a non-contact method for measuring the deformation of bodies using machine vision technology, which makes it possible to eliminate the disadvantages of contact methods and reduce the complexity of preparing an experiment, as well as minimize the number of mathematical operations required to calculate the absolute values of deformation.*

Keywords: *machine vision, strain measurement.*

Machine vision systems have recently been actively developing and are used in various fields of technology [1]. This article discusses the possibility of using such a system for the non-contact measurement of small displacements of objects or their deformations. Usually, for these purposes, stands with strain gauges are used, which have a number of significant disadvantages [4]:

- strong influence of the ambient temperature on the sensor readings;
- resistance and sensor error are highly dependent on the material of the support and the adhesive with which the load cell is attached to the test piece. The fluidity of the substrate and the adhesive causes hysteresis;
- low mechanical strength. Under intense dynamic loads, the base may peel off.
- the complexity of the quantitative assessment of deformation according to the data obtained from the strain gauges;
- long preparation time for the bench test.

Machine vision systems are obviously devoid of the listed disadvantages. However, the question arises about the method of measuring deformation using such systems.

The most obvious options for this measurement are:

• the use of two or three high-resolution video cameras, the geometric position of which is precisely known, and the determination of the angles at which the point (more precisely, the marker indicating this point) is visible, the movement of which is measured. Then, from trigonometric relations, this displacement can be calculated quite accurately from the change in angular coordinates measured by two cameras.

• use of one high-resolution video camera, as well as a marker on the object under investigation, the shape and size of which are precisely known. Then, according to the change in the angular position of the point (marker) on the matrix and the size of its image, the actual movement is calculated. It requires precise knowledge of the size and shape of the marker and accurate measurement of not only the position of the marker image, but also the size and orientation of this image.

Both described options require time-consuming preparation and, in particular, the second, rather complex mathematical processing of the results. The approach proposed in this article is largely free of these shortcomings. It is based on the fact that two arbitrarily fixed stationary cameras are used, and for alignment (determining the position of the cameras relative to each other in the common measurement space), use a reference, precisely manufactured tetrahedron of a certain shape. Three of its edges are mutually orthogonal, have the same exactly known length, and represent the unit vectors of a certain Cartesian coordinate system, which we will further call absolute. Each camera has its own local coordinate system, which we will call camera. One of the axes of this system coincides with the optical axis of the camera, the other two are orthogonal to it and to each other. Presetting consists in calculating the transformation of point coordinates from camera to absolute coordinate system. Next, you should find the ray directed from the origin of the camera coordinate system to the point under study and translate its equation into the absolute coordinate system for both cameras. The coordinates of the point of intersection of these rays will be the absolute coordinates of the point under study.

Let us describe in more detail the setup procedure, for which it is required to enter designations and formulate some preliminary statements:

• Each point in space, more precisely that part of space that is contained within the angle (cone) of the camera's view, has absolute coordinates X_a, Y_a, Z_a, camera coordinates X_k, Y_k, Z_k, different for each camera, in addition, the image of this point is also a point, which has its coordinates on the camera matrix in the matrix coordinate system X_m, Y_m. The matrix is conventionally assumed to be located in a plane orthogonal to the Z_k axis. The X_m, Y_m axes of the matrix coordinate system are parallel to the same-named axes of the camera system, and the Z_k axis of the camera system passes through the origin of the matrix system, which we will align

with the center of symmetry of the matrix. We assume that the Z_k axis is projected to the origin of the matrix system.

• A certain ray is projected onto each point of the matrix, which lies in a plane passing through the axis of optical symmetry of the camera (Z_k axis of the camera coordinate system). Suppose that all such rays intersect at one point lying on the optical axis of symmetry of the camera. We will take this point as the origin of the camera system. This assumption should be fulfilled in the case when the camera does not give nonlinear distortion, does not have astigmatism.

In this case, such a ray can be described by the equalities [3]

$$X_k = K_x \cdot Z_k, \quad Y_k = K_y \cdot Z_k, \tag{1}$$

where the coefficients K_x, K_y are related to the matrix coordinates of the image of this ray X_m, Y_m. This relationship will be linear and can be written as:

$$X_k = k_x \cdot X_m \cdot Z_k, \quad Y_k = k_y \cdot Y_m \cdot Z_k. \tag{2}$$

We place an adjustment tetrahedron in the field of view of the camera, three edges of which are perpendicular to each other. The vertices of this tetrahedron, To, Tx, Ty, Tz, will be considered, respectively, as *To* – the origin of coordinates of the absolute system, vectors (directed segments) with origin at point *To* and ends at points Tx, Ty, Tz will then be the orts of the absolute coordinate system. The matrix coordinates of these points, that is, the coordinates of their images on the photosensitive matrix of the camera, will be designated accordingly

$$To_m = \left(To_{mx}, To_{my}\right),\ Tx_m = \left(Tx_{mx}, Tx_{my}\right),\ Ty_m = \left(Ty_{mx}, Ty_{my}\right),\ Tz_m = \left(Tz_{mx}, Tz_{my}\right).$$

The matrix coordinate system is two-dimensional, so only two coordinates correspond to each point in it.

The coordinates of the vertices of the tetrahedron in the camera coordinate system are denoted as follows:

$$To = \left(To_{kx}, To_{ky}, To_{kz}\right),\ Tx = \left(Tx_{kx}, Tx_{ky}, Tx_{kz}\right),$$
$$Ty = \left(Ty_{kx}, Ty_{ky}, Ty_{kz}\right),\quad Tz = \left(Tz_{kx}, Tz_{ky}, Tz_{kz}\right),$$

then, in accordance with the following relations are valid:

$$\begin{aligned} To_{kx} &= k_x \cdot To_{mx} \cdot To_{kz},\ To_{ky} = k_y \cdot To_{my} \cdot To_{kz}, \\ Tx_{kx} &= k_x \cdot Tx_{mx} \cdot Tx_{kz},\ Ty_{ky} = k_y \cdot Ty_{my} \cdot Ty_{kz}, \\ Ty_{kx} &= k_x \cdot Ty_{mx} \cdot Ty_{kz},\ Ty_{ky} = k_y \cdot Ty_{my} \cdot Ty_{kz}. \end{aligned} \tag{3}$$

Six parameters are not defined in equalities: $k_x, k_y, To_{kz}, Tx_{kz}, Ty_{kz}, Tz_{kz}$.

To define them, we use the fact that the camera coordinate system is orthogonal Cartesian and we know the unit lengths, which we will assume to be unit for simplicity of calculations, as well as the fact that the unit vectors are pairwise orthogonal. This allows you to write six equations [3]:

$$\begin{aligned}
&(Tx_{kx}-To_{kx})^2+(Tx_{ky}-To_{ky})^2+(Tx_{kz}-To_{kz})^2=1,\\
&(Ty_{kx}-To_{kx})^2+(Ty_{ky}-To_{ky})^2+(Ty_{kz}-To_{kz})^2=1,\\
&(Tz_{kx}-To_{kx})^2+(Tz_{ky}-To_{ky})^2+(Tz_{kz}-To_{kz})^2=1,\\
&(Tx_{kx}-Ty_{kx})^2+(Tx_{ky}-Ty_{ky})^2+(Tx_{kz}-Ty_{kz})^2=2,\\
&(Tx_{kx}-Tz_{kx})^2+(Tx_{ky}-Tz_{ky})^2+(Tx_{kz}-Tz_{kz})^2=2,\\
&(Tz_{kx}-Ty_{kx})^2+(Tz_{ky}-Ty_{ky})^2+(Tz_{kz}-Ty_{kz})^2=2.
\end{aligned} \tag{4}$$

The first three equations in describe the relationship between the coordinates of the ends of the orthogonal edges of the tetrahedron and the lengths of these edges, and the last three describe the distances between the ends of the unit vectors (according to the spatial Pythagorean theorem).

Instead of the last three equations, you can write down others based on the fact that the scalar product of orthogonal vectors is equal to zero, and then instead of it will be written:

$$\begin{aligned}
&(Tx_{kx}-To_{kx})^2+(Tx_{ky}-To_{ky})^2+(Tx_{kz}-To_{kz})^2=1,\\
&(Ty_{kx}-To_{kx})^2+(Ty_{ky}-To_{ky})^2+(Ty_{kz}-To_{kz})^2=1,\\
&(Tz_{kx}-To_{kx})^2+(Tz_{ky}-To_{ky})^2+(Tz_{kz}-To_{kz})^2=1,\\
&(Tx_{kx}-To_{kx})\cdot(Ty_{kx}-To_{kx})+(Tx_{ky}-To_{ky})\cdot(Ty_{ky}-To_{ky})+(Tx_{kz}-To_{kz})\cdot(Ty_{kz}-To_{kz})=0,\\
&(Tx_{kx}-To_{kx})\cdot(Tz_{kx}-To_{kx})+(Tx_{ky}-To_{ky})\cdot(Tz_{ky}-To_{ky})+(Tx_{kz}-To_{kz})\cdot(Tz_{kz}-To_{kz})=0,\\
&(Tz_{kx}-To_{kx})\cdot(Ty_{kx}-To_{kx})+(Tz_{ky}-To_{ky})\cdot(Ty_{ky}-To_{ky})+(Tz_{kz}-To_{kz})\cdot(Ty_{kz}-To_{kz})=0.
\end{aligned} \tag{5}$$

If no two vertices of the tetrahedron have coincident images, equations and (5) are independent and have a unique solution. Solving them, we get the full coordinates of the unit vectors of the absolute system in the camera coordinate system. However, our goal is to translate the coordinates of any point from the camera system to the absolute one. To solve this problem, we first derive the inverse transformation - from the absolute to the chamber one.

Converting one coordinate system to another involves two steps: translation and rotation. The shift corresponds to moving the origin to the origin of the tar-

get system, in our case, the camera system. Therefore, the displacement vector is equal to $B = To_k$ – coordinates of point O in the camera coordinate system. The second stage, rotation, is specified by the rotation matrix A, the columns of which are the coordinates of the unit vectors of the original system in the target coordinate system.

$$A = \begin{pmatrix} Tx_{kx} - To_{kx} & Ty_{kx} - To_{kx} & Tz_{kx} - To_{kx} \\ Tx_{ky} - To_{ky} & Ty_{ky} - To_{ky} & Tz_{ky} - To_{ky} \\ Tx_{kz} - To_{kz} & Ty_{kz} - To_{kz} & Tz_{kz} - To_{kz} \end{pmatrix}, \; B = \begin{pmatrix} To_{kx} \\ To_{ky} \\ To_{kz} \end{pmatrix}. \quad (6)$$

Let any arbitrary point G have coordinates G_a, in the absolute system, and coordinates G_k in the camera system, then the following equations are valid:

$$G_a = \begin{pmatrix} G_{ax} \\ G_{ay} \\ G_{az} \end{pmatrix}, \; G_k = \begin{pmatrix} G_{kx} \\ G_{ky} \\ G_{kz} \end{pmatrix}, \; G_k = A \cdot (G_a - B). \quad (7)$$

Then the reverse transformation of coordinates will be performed according to the formula [3]:

$$G_a = A^{-1} \cdot G_k + B. \quad (8)$$

Since each column of the matrix A is a vector of the unit Euclidean norm (see), and all its columns are pairwise orthogonal, finding the inverse matrix of the given one is equivalent to transposition, and relation takes the form:

$$G_a = A^{\mathrm{T}} \cdot G_k + B. \quad (9)$$

For each camera its own matrix of transition from camera to absolute coordinate system is defined.

Consider now the definition of the absolute coordinates of a point in space. This will require two cameras with already defined transition matrices from the camera system to the absolute one, which see this point. Let's designate X_{1m}, Y_{1m} matrix coordinates of this point for the first camera, X_{2m}, Y_{2m} matrix coordinates of this point for the second camera. The proportionality coefficients for the transition from a matrix system to a chamber system are denoted by k_{1x}, k_{1y} and k_{2x}, k_{2y} for the first and second chambers, respectively. A whole ray is projected into a pixel on the matrix, passing through the origin of the camera coordinate system. Let's denote the coordinates of two points of the beam for the camera system of the first camera G_{k11} and G_{k12}:

$$G_{k11} = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}, \; G_{k12} = \begin{pmatrix} k_{1x} X_{1m} Z_{1k} \\ k_{1y} Y_{1m} Z_{1k} \\ Z_{1k} \end{pmatrix} \tag{10}$$

We introduce similar designations for the ray points of the second camera system:

$$G_{k21} = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}, \; G_{k22} = \begin{pmatrix} k_{2x} X_{2m} Z_{2k} \\ k_{2y} Y_{2m} Z_{2k} \\ Z_{2k} \end{pmatrix} \tag{11}$$

The rays passing through the origin and the corresponding points Z_{1k} and Z_{1k} can be defined as:

$$\begin{pmatrix} x_{1k} \\ y_{1k} \\ z_{1k} \end{pmatrix} = \begin{pmatrix} k_{1x} X_{1m} Z_{1k} \\ k_{1y} Y_{1m} Z_{1k} \\ Z_{1k} \end{pmatrix} \tag{12}$$

$$\begin{pmatrix} x_{2k} \\ y_{2k} \\ z_{2k} \end{pmatrix} = \begin{pmatrix} k_{2x} X_{2m} Z_{2k} \\ k_{2y} Y_{2m} Z_{2k} \\ Z_{2k} \end{pmatrix} \tag{13}$$

For both rays, we will transform from camera coordinate systems to absolute. Let A_1 and A_2 denote matrices of transitions from one basis to another for the first and second cameras, and B_1 and $B2$ – vectors of displacements of the bases also for the first and second cameras. Then, proceeding from (9), we obtain the following coordinates of the rays in the absolute system:

$$\begin{pmatrix} x_{1a} \\ y_{1a} \\ z_{1a} \end{pmatrix} = A_1^T \begin{pmatrix} x_{1k} \\ y_{1k} \\ z_{1k} \end{pmatrix} + B_1$$
$$\begin{pmatrix} x_{2a} \\ y_{2a} \\ z_{2a} \end{pmatrix} = A_2^T \begin{pmatrix} x_{2k} \\ y_{2k} \\ z_{2k} \end{pmatrix} + B_2 \tag{14}$$

Since both of these rays pass through the same point G, the absolute coordinates of this point will be the solution to the equation:

$$\begin{pmatrix} x_{1a} \\ y_{1a} \\ z_{1a} \end{pmatrix} = \begin{pmatrix} x_{2a} \\ y_{2a} \\ z_{2a} \end{pmatrix}. \quad (15)$$

Equation (15) contains only two free variables Z_{1k}, Z_{2k}, but there are three equations themselves, that is, the system is redefined and the exact solution cannot be found. To solve this problem, we minimize the residual norm:

$$\varepsilon(z_{1k}, z_{2k}) = \left\| \begin{pmatrix} x_{1a}(z_{1k}) \\ y_{1a}(z_{1k}) \\ z_{1a}(z_{1k}) \end{pmatrix} - \begin{pmatrix} x_{2a}(z_{2k}) \\ y_{2a}(z_{2k}) \\ z_{2a}(z_{2k}) \end{pmatrix} \right\| \to \min_{z_{1k}, z_{2k}}. \quad (16)$$

The problem has the only solution that can be found by equating to zero the partial derivatives

$$\frac{\partial \varepsilon(z_{1k}, z_{2k})}{\partial z_{1k}} = 0, \quad \frac{\partial \varepsilon(z_{1k}, z_{2k})}{\partial z_{2k}} = 0. \quad (17)$$

Taking into account the nature of dependences (9) - (16), it is clear that system (17) is a non-degenerate system of linear algebraic equations and can be solved. Substituting the obtained solution into (15), we obtain the absolute coordinates of two points G_{1a}, G_{2a}, which are points with a minimum distance between two rays. For the position of the point G we take the arithmetic mean of the coordinates of the points G_{1a}, G_{2a}

By analyzing the position of a point of interest in the matrix coordinate systems of cameras many times and applying the above transformations, one can directly track the dynamics of a point's movement in space [2] and, accordingly, draw conclusions about the deformation of an object whose surface this point belongs to.

References

1. Gridin V.N., Titov V.S., Trufanov M.I. Adaptive vision systems / ISBN: 978-5-02-025391-9, Publishing house: Science, 2009.

2. Processing and analysis of digital images with examples in LabVIEW and IMAQ Vision / Yu.V. Wiesilter et. al. - M.: DMK Press, 2016. - 464 P.

3. Rudyk, B.M. Linear Algebra: Textbook / B.M. Rudyk. - M.: SRC INFRA-M, 2013. - 318 P.

4. Sharapov V.M., Polishchuk E.S., Koshevoy N.D., Ishanin G.G., Minaev I.G., Sovlukov A.S. Sensors: Reference Guide / Under gen. ed. V.M. Sharapova, E.S. Polishchukayu Moscow: Technosphere, 2012. 624 P., ISBN 978-5-94836-316-5

DOI 10.34660/INF.2020.71.14.029

制定区域农业部门适应气候变化的适应计划：任务，解决方案，所用信息
DEVELOPMENT OF ADAPTATION PLAN FOR THE REGIONAL AGRICULTURAL SECTOR TO CLIMATE CHANGE: TASKS, SOLUTIONS, INFORMATION USED

Ashabokov Boris Azretalievich
Doctor of Physics and Mathematics Sciences, Full Professor
Head of Department of Cloud Physics
High-Mountain Geophysical Institute, Nalchik, Russia;
Head of Department of Institute of Computer Science and Problems of Regional Management
Kabardino-Balkarian Research Center, Russian Academy of Sciences, Nalchik, Russia.

抽象。 本文讨论了可能制定的区域农业部门适应计划，以减少与气候变化有关的风险。 更具体地说，考虑了减少“缓慢的”气候变化对农业造成的损失的问题，例如一年中不同季节的降水量和平均地表气温。 讨论了此问题的信息支持功能以及在实际使用中出现的主要任务。 计算结果用于分析所提出的减少农业损失的方法的有效性。 计算结果表明，该方法是有效的，可用于减少农业损失。

关键词：农业；“慢”气候变化；适应计划；农作物产量；动态模型

Abstract. *The paper discusses possible development of adaptation plan of the regional agricultural sector to reduce the risks associated with climate change. More specifically, the problem of reducing agricultural losses from “slow” climate change such as the amount of precipitation and the average surface air temperature in different seasons of the year is considered. The features of the information support of this problem and the main tasks arising in the way of its practical use are discussed. The results of calculations that are carried out to analyze the effectiveness of the proposed method of reducing agricultural losses. The results of the calculations showed that the method is quite effective and can be used to reduce agricultural losses.*

Keywords: *agriculture, “slow” climate change, adaptation plan, , the yield of agricultural crops, dynamic model*

The development of adaptation plan of the regional agricultural sector to climate change is associated with a number of tasks, which include:

1. Analysis and forecast of the dynamics of natural factors that determine the yield of agricultural crops.

2. Building models of agroclimatic resources, calculating their values on the adaptation interval.

3. Analysis and forecast of changes in the production and economic conditions of the functioning of agriculture and the agro-industrial complex (technologies for the production and processing of agricultural products, the cost of their production and processing, demand for agro-industrial complex products, etc.) during the adaptation interval.

4. Determination of target indicators of agro-industrial complex development in the adaptation interval, development of the model and their coordination.

5. Development of climate-saving agrotechnical measures, with the help of which it is possible to bring crop yields due to natural factors to target indicators.

6. Development of the model and study of various scenarios for the production and processing of agricultural crops in the adaptation interval in order to determine the most promising of them.

7. Development of a method and selection of the most acceptable scenario for adapting the agro-industrial complex to climate change.

8. Selecting a system of target indicators and developing the method for analyzing the effectiveness of adaptation measures and monitoring the implementation of adaptation plans to climate change.

9. Optimization of the functioning of support services (supply and maintenance services for technical means and equipment, supply of fertilizers, construction of various facilities, scientific support of the agro-industrial complex, training and retraining of specialists, etc.) taking into account climate change.

Let us dwell on the content of these tasks and the information required to solve them.

As a result of solving problem 1, tendencies of changes in the adaptation interval of natural factors that determine crop yields are determined. These include meteorological parameters characterizing the temperature regime of the air in the surface layer of the atmosphere (average, maximum and minimum temperatures of the surface air) and the regime of atmospheric precipitation (amount of precipitation, intensity of precipitation, the number of days with precipitation over 20 mm) in different seasons of the year [2, 3].

The solution to problem 2 is aimed at building models of agro-climatic resources (integral functions describing the dependence of crop yields on natural factors), which are used to determine the lower limit of crop yields, which is necessary for agriculture to adapt to climate change.

As such factors, the amount of precipitation and the average surface air temperature in different seasons of the year are used [2]. For some regions, including the south of Russia, to them, in our opinion, it is advisable to add maximum summer temperatures, which can significantly affect the formation of crops.

To solve problem 1, time series of meteorological parameters are used that characterize the temperature regime of the surface air and atmospheric precipitation. They are available, and their measurement accuracy is quite high. They can be represented as discrete random variables with known probability distribution laws. The parameters of these laws can change over time due to climate change.

The solution of problem 2 together with the time series of meteorological parameters requires the use of time series of crop yields formed by natural factors. If such series exist for natural factors, then there are no time series of crop yields, and their receipt is associated with long-term field experiments. In work [2], for this purpose, data on crop yields in the 90s and subsequent years were used, when the use of fertilizers and plant protection chemicals in agriculture in the Russian Federation was close to zero. These data are not discrete random variables, but it can be assumed that the limits of their values change are known, their accuracy is low.

To solve the problem, you can use the least squares method. On the way to providing information for task 3, considerable difficulties may arise. To solve this problem, the most effective, apparently, will be the use of expert methods.

The content of problem 4 and the method for its solution are discussed in [1,2]. On the way to solving this problem, difficulties arise due to the fact that it is required to find and agree on target indicators for the development of the agro-industrial complex within the framework of the resources used, technologies for processing agricultural products, etc. At the same time, to determine target indicators of crop yields, one can use, for example, an expert method or predict them. As for the target indicators of the processing industry, serious difficulties arise in the way of their definition and agreement. They consist in the fact that their definition is possible only on the basis of a model that takes into account the processes of production and processing of all agricultural crops. In [1,2], a relatively simple linear program model is presented that can be used to solve this problem.

The urgency of solving problem 5 increases in modern conditions, when the natural factors affecting the productivity of agricultural crops change at a rather high rate [2,4,6]. The feasibility of its production will depend on the possibility of bringing the yield of a particular crop to the target indicator, depending on this, one crop should be replaced with another. The effectiveness of existing agronomic techniques may not be sufficient to solve this problem. In this regard, the development of new effective techniques for solving this problem should be given increased attention.

An important task is to determine the development trajectories of the agro-industrial complex in the adaptation interval. Difficulties in solving it are due to the fact that it requires the development of a model for the production and processing of agricultural crops under various external and internal conditions. The results of studies of changes in these conditions will be used to determine scenarios for the development of the agro-industrial complex, from which the most acceptable one should be selected in the current conditions. Modeling of scenarios for the development of the agro-industrial complex can be carried out on the basis of the algorithm described below and based on the use of a model for coordinating target indicators of the agro-industrial complex development.

As for problem 7, to solve it, i.e. to select the most acceptable of the possible scenarios for adapting the agro-industrial complex to climate change, there are quite effective methods [5].

When solving problem 8, it should be borne in mind that as a result of adaptation measures, the sectors of the economy should achieve indicators that allow them to perform their functions (ensuring the country's food security, providing the sectors of the economy with raw materials). The conditions imposed on their functioning must also be met, for example, on the volume of agricultural crops production, on emissions of pollutants and greenhouse gases, etc. In addition, if the region's agro-industrial complex is able to export its products, this will be a source of budget revenues.

In this regard, as a system of target indicators in the development of methods for analyzing the effectiveness of adaptation measures and monitoring the implementation of adaptation plans, indicators should be used that characterize the efficiency of the industry, its impact on the climate, on the social sphere, the provision of the country with food, and related industries. raw materials, etc. However, considerable difficulties can arise when constructing an indicator that allows one to reliably and quickly determine the effectiveness of adaptation measures to climate change, monitor the quality of implementation of adaptation plans, and assess the degree of achievement of adaptation goals. For this, it is expedient, in our opinion, to construct such indicators that allow analyzing the deviations of the achieved indicators of the agro-industrial complex from the target ones. As for the problem of optimizing auxiliary services (task 9), its solution is also possible within the framework of linear programming.

Let us dwell further on the problem of determining various scenarios for the development of the agro-industrial complex on the adaptation interval. Obviously, the indicators of the agro-industrial complex (crop yields and production volumes of agricultural crops, the volume of their processed products, production and economic indicators, etc.) will change over time. Agro-climatic resources that determine crop yields will also change over time. Therefore, it would be natural for

solving this problem to use a dynamic model, which would take into account the changes in time of the indicators of the agro-industrial complex and the conditions of its functioning. But the development of such a model encounters serious difficulties, which makes it promising to use the model developed to determine and agree on target indicators for the development of the agro-industrial complex [1,2]. The advantage of this model is that it manages to take into account the production and processing of all crops.

One of the options for recording the objective function of the model is to write it in the form:

$$P = \sum_{j=1}^{m} \left(c_{n+j} - z_{n+j}\right) x_{n+j} \rightarrow \max, \quad (1)$$

where P – profit of the processing industry, c_{n+j} – profit from the sale of a unit of the j – th type of product, z_{n+j} – cost of production of a unit of the j– th type of product.

The model's constraint system is written as:

- restrictions on the use of land resources:

$$\sum_{i=1}^{n} x_i \le x_0, \quad (2)$$

- restrictions taking into account the observance of crop rotation in agriculture:

$$x_i = \alpha_i x_0, \quad \left(i = \overline{1,n}\right), \quad (3)$$

where is the share of arable land occupied by the i -th crop.

- restrictions imposed on the volume of crop production

$$Y_i x_i \ge u_i, \quad \left(i = \overline{1,n}\right), \quad (4)$$

where Y_i is the yield and u_i is the minimum production volume of the i-th crop.

- restrictions taking into account the use of the industry's financial resources:

$$\sum_{i=1}^{n} Y_i s_i x_i \le F_0^{(1)}, \quad (5)$$

s_i – production cost of the i-th culture.

- restrictions taking into account the technology of processing crops:

$$\sum_{j=1}^{m} \alpha_{i,n+j} x_{n+j} = Y_i x_i, \quad (6)$$

- the volume of expenses of the i-th culture for the production of a unit of the j-th type of product in the processing industry;

- restriction on the use of financial resources in the processing industry:

$$\sum_{j=1}^{m} x_{n+j} z_{n+j} = F_0^{(2)}, \quad (7)$$

- restrictions on the volume of production in the processing industry:

$$x_{n+j} \geq v_j \quad \left(j = \overline{1,m}\right) \quad (8)$$

It can be seen that *m*-types of products are produced in the processing industry and all crops are used. Using crop yield models and the values of production and economic indicators of industries as input data, it is possible to find agreed target indicators for the development of the agro-industrial complex.

As you can see, the model is stationary, which can be considered a significant drawback. Therefore, to solve problem 6 using this model, an algorithm was used, which is presented below. Let's introduce a grid tk on the time axis (k = 1,2,3, ..., N). The minimum grid step size is 1 year. Let the values of the target indicator of the yield of the *i*-th crop and the yield of this crop, formed by natural factors, be known at the nodes of the grid: $У^k_{ci}$ and $У^k_{ni}$. Note that the values of Укці are determined based on the needs of the region for food products and raw materials, and the values of $У^k_{ni}$, as shown above, are determined using the dynamics of natural factors that determine crop yields in the adaptation interval. Thus, information on climate change is used only when determining the values of $У^k_{ni}$ (k = 1,2,3, ..., N) over the adaptation interval.

Then the solution to problem 6 will consist in defining and agreeing at each time step of the target indicators for the development of the agro-industrial complex based on the model (1) - (8). Therefore, the model should take into account the measures necessary to bring crop yields from $У^k_{ni}$ (k = 1,2,3, ..., N) to target indicators. They can be accounted for in various ways, for example, by adding the costs of these activities to the cost of production of crops.

Using the model (1) - (8) and the described algorithm, calculations were carried out to determine and agree on target indicators and determine scenarios for the development of the agro-industrial complex of the steppe zone of the Kabardino-Balkarian Republik (KBR, Southern Russia). Taking into account the current state in the development of this sector of the economy, three stages were identified. In the first of them, which will cover a five-year period of time, the task, in our opinion, should be to restore the production potential of the agro-industrial complex and carry out its structural transformations. Therefore, it was assumed that in this period of time one should not expect a noticeable increase in the indicators of the agro-industrial complex, including crop yields.

At the next stage, which covers the same period of time, it was assumed that an effective management system for the agro-industrial complex based on the use of

modern scientific achievements would be created, conditions for the introduction of modern achievements of science and technology in the agro-industrial complex would be created, a regional innovation system would be created, etc. etc. Thus, by the end of this period of time, it is planned to create an efficiently functioning agro-industrial complex.

Based on this, in the calculations for this period of time, higher target indicators for crop yields were used than in the first period of time. The following values were used: 40 c /ha for wheat and cereals, 60 c /ha for corn, 200 c /ha for potatoes, sugar beet and vegetables, 25 c /ha for sunflower, 350 c /ha for fruits, 35 c / ha for grapes. Assuming that the increase in crop yields at a given time interval occurs according to a linear law, problem (1) - (8) was solved with a time step of 1 year.

The third stage in the development of the agro-industrial complex, lasting about 5 years, should be the stage in which the agro-industrial complex enters a sustainable development mode. In this period of time, a system of agricultural enterprises with an effective structure and effective scientific support should be formed. As noted, the indicators of the agro-industrial complex at the end of this period of time should be at the level of the indicators of the agro-industrial complex in Germany, the target indicators of crop yields, for example, were equal: 74 c / ha for wheat, 56 c / ha for barley, 92 c / ha for corn, 403 c / ha for potatoes, 593c / ha for sugar beet, 1244c / ha for tomatoes, 57c / ha for grapes. And in this case, assuming that the increase in crop yields at a given time interval occurs according to a linear law, problem (1) - (8) was solved with a time step of 1 year. Table 1 shows the results of calculating the indicators of the agro-industrial complex at the end of the third stage.

An analysis of the calculation results corresponding to different input data showed that the structure of the cultivated areas in the region is relatively stable. Noticeable changes are observed in the structure of products of the processing industry. According to the results of calculations, under the assumptions made, the agricultural sector already at the first stage becomes profitable - the value of the objective function turned out to be 8779,23 thousand rubles. (per 1000 hectares of arable land). Studies of the sensitivity of the AIC indicators to variations in the input data of the model showed that they are most sensitive to changes in the volume of financial resources. All indicators of the industry are sensitive to their variations: the structure of cultivated areas, the structure of products of the processing industry, the distribution of financial resources between various production areas, and others.

Table 1 - *Indicators of the agro-industrial complex at the end of the third stage of development (per 1000 ha)*

Arable land under agricultural crops (ha)			
$x_1 = 364,0$ $x_5 = 3,5$ $x_9 = 33,0$	$x_2 = 200,0$ $x_6 = 40,0$ $x_{10} = 0,5$	$x_3 = 143,0$ $x_7 = 38,0$	$x_4 = 147,8$ $x_8 = 0,25$
Production volumes in the processing industry (c)			
$x_{11} = 877,0$ $x_{12} = 14,0$ $x_{13} = 1370,0$ $x_{14} = 0,0$ $x_{15} = 10,0$ $x_{16} = 21,0$ $x_{17} = 15,0$ $x_{18} = 10,0$ $x_{19} = 190,31$ $x_{20} = 10,0$ $x_{21} = 10,0$	$x_{22} = 10$ $x_{23} = 165,0$ $x_{24} = 10,0$ $x_{25} = 12,0$ $x_{26} = 10,0$ $x_{27} = 21,0$ $x_{28} = 19,0$ $x_{29} = 6,44$ $x_{30} = 0,0$ $x_{31} = 215,4$ $x_{32} = 0,0$	$x_{33} = 14,0$ $x_{34} = 0,0$ $x_{35} = 115,0$ $x_{36} = 0,0$ $x_{37} = 141,7$ $x_{38} = 310,0$ $x_{39} = 10,0$ $x_{40} = 31,0$ $x_{41} = 30$ $x_{42} = 10.0$ $x_{43} = 949,2$	$x_{44} = 10,0$ $x_{45} = 14,7$ $x_{46} = 0,0$ $x_{47} = 10,0$ $x_{48} = 0,0$ $x_{49} = 2,1$ $x_{50} = 10$ $x_{51} = 10$ $x_{52} = 10$ $x_{53} = 10,0$ $x_{54} = 31,0$ $x_{55} = 10,0$
Financial costs for processing agricultural crops (thousand rubles)			
$x_{56} = 53310,7$ $x_{57} = 2000,0$ $x_{58} = 463,3$	$x_{59} = 4507,7$ $x_{60} = 2300,0$ $x_{61} = 1866,7$	$x_{62} = 13809,9$ $x_{63} = 1264,3$	$x_{64} = 600,0$ $x_{65} = 2117,5$
Crop production volumes (c)			
$x_{66} = 2478,2$ $x_{67} = 300,0$ $x_{68} = 1053,2$	$x_{69} = 200,0$ $x_{70} = 974,0$	$x_{71} = 4140,0$ $x_{72} = 300,0$	$x_{73} = 20,0$ $x_{74} = 186,0$
Expenditures of financial resources for the processing of agricultural crops (thousand rubles)		Expenditures of financial resources for the production of crops (thousand rubles)	
$x_{75} = 82240.2$		$x_{76} = 25462,7$	

The costs of processing agricultural crops depend on the structure of the products of the processing industry, which undergoes noticeable changes over time. The functioning of the processing industry requires more financial resources than the functioning of agriculture: 82240,2 and 25462,7 thousand rubles, and the profit (values of the objective function) is equal to 19096.6 thousand rubles. (per 1000 hectares of arable land). The volume of crop production is also increasing. In monetary terms (in prices of 2009), the volume of agricultural crops production is

equal to: 13370,8 million rubles. in 2030 and 3330,0 million rubles. in 2009, i.e. there is a noticeable increase in this indicator.

References

1. Ashabokov B.A., Baleva L.M., Tauchev Z.O. On the model of agreement and forecasting of production and economic indicators of the agro-industrial complex and some results of calculations // Financial analytics: problems and solutions. - 2011.-24 (66) .- Pp.67-71.

2. Ashabokov B.A., Fedchenko L.M., Tashilova A.A., Kesheva L.A., Teunova N.V. Spatio-temporal climate change in the south of the European territory of Russia, assessment of its consequences, methods and models of agro-industrial complex adaptation. - Nalchik: LLC "Fregat", 2020. – 476 p.

3. Ashabokov B.A., Tashilova A.A., Kesheva L.A., Taubekova Z.A. Climatic changes in mean values and extrema of near-surface air temperature in the south of the European territory of Russia. Fundamental and Applied Climatology. No. 1, 2017 - Pp. 5-19.

4. Zoidze E.K., Khomyakova T.V., Shostak Z.A. et al. On the problem of adequate agroclimatic provision of the economy of the Russian Federation in conditions of climate change // Meteorology and Hydrology, 2010, No. 8, Pp.73-86.

5. Keeney RL, Raifa H. Decision making under multiple criteria: preferences and substitutions. - M .: radio and communication, 1981. - 560 p.

6. Khrabrskov E. Management of grain production taking into account risks // APK: economics, management. - 2011. - No. 2. - Pp. 26-30.

DOI 10.34660/INF.2020.36.57.030

创建评估模型以选择地下浸出垫的最佳位置
CREATION OF A RATING MODEL FOR THE SELECTION OF THE OPTIMAL LOCATION OF UNDERGROUND LEACHING PADS

Goncharov Denis Sergeevich
Candidate of Technical Sciences, Research Officer
Razmakhnin Konstantin Konstantinovich
Candidate of Technical Sciences, Head of the Chita branch of the
Razmakhnina Irina Borisovna
Research Officer
N.A. Chinakal Institute of Mining, SB RAS

抽象。 考虑开发一个为地下浸出地点的位置提供最佳参数的评估模型的问题。 已经确定，确保选择最佳ISL选址的基本过程是构造矿体块模型。 建立与开发的模型相对应的优化标准。 给出了建模的主要阶段。 结果表明，在对矿体进行建模时，岩石的碳酸盐含量非常重要，碳酸盐含量是岩石中碳酸盐矿物的总含量或质量含量。 确定要获得孔隙度模型，必须创建该领域的岩性差异的线框模型。 给出了建立地下水模型的阶段。

关键词：地下浸出，有价值成分的提取，评估模型，参数，地点。

Abstract. *The issue of developing a rating model that provides the most optimal parameters for the location of the underground leaching site is considered. It has been determined that the fundamental process that ensures the selection of the optimal ISL site is the construction of a block model of the ore body. The optimization criteria corresponding to the developed model are established. The main stages of modeling are given. It is indicated that when modeling an ore body, the carbonate content of rocks, which is the total percentage or mass content of carbonate minerals in the rock, is of great importance. It was determined that to obtain a porosity model, it is necessary to create wireframe models of the lithological differences of the field. The stages of building a groundwater model are given.*

Keywords: *underground leaching, extraction of a valuable component, rating model, parameters, site.*

Underground leaching is an alternative to methods of open and underground mining of mineral deposits, in comparison with which, the method of underground

hydrometallurgical extraction of valuable components does not require a large volume of excavations or direct contact of workers with rocks at their location. At the same time, underground leaching is quite effective for deep-seated ores [1, 2].

One of the most important tasks for developing a deposit using the in situ leaching method is the choice of the optimal site location, the choice of which is due to the fulfillment of a certain list of conditions, such as the presence of ore with standard grades, suitable properties of the enclosing rocks, the presence of groundwater in the upper horizons, etc. As a result of the analysis of possible factors influencing the formation of the model, the following optimization criteria were selected: the content of the mineral in the ore; carbonate content of rocks; ground water level; porosity value of rocks; the amount of fracturing of rocks [3,4].

For universal work with the full array of available data, as well as easy visualization of the initial materials and design parameters, it is recommended to implement all models based on one of the popular mining and geological systems (DataMine, Surpac, Micromine, etc.). The main stages of modeling are shown in figure 1.

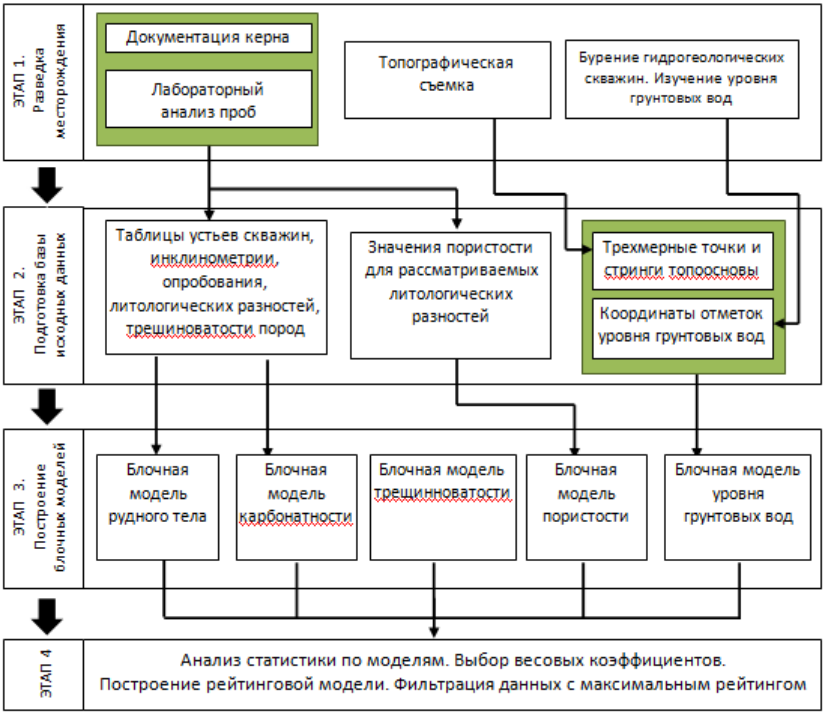


Fig. 1. *Block diagram of the rating model creation*

The fundamental process that ensures the selection of an optimal ISL site is the construction of a block model of the ore body. The model is built on the basis of sampling data, with the limitation of ore bodies by pre-built frameworks (figure 2). The assay data is interpolated to a block model in compliance with the zone control rules. The combined elevation plans of an exemplary Cond is shown in figure 3.

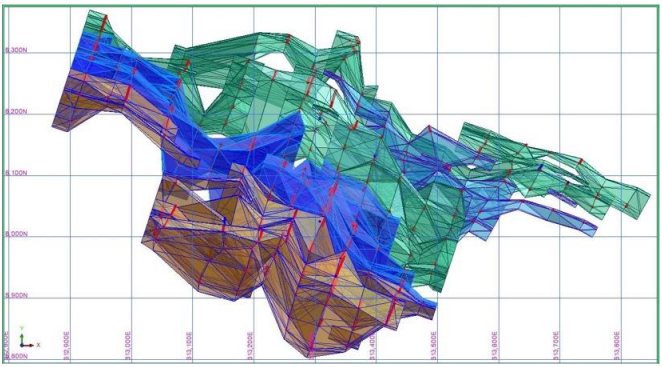


Fig. 2. *Wireframe model of the ore body with samples*

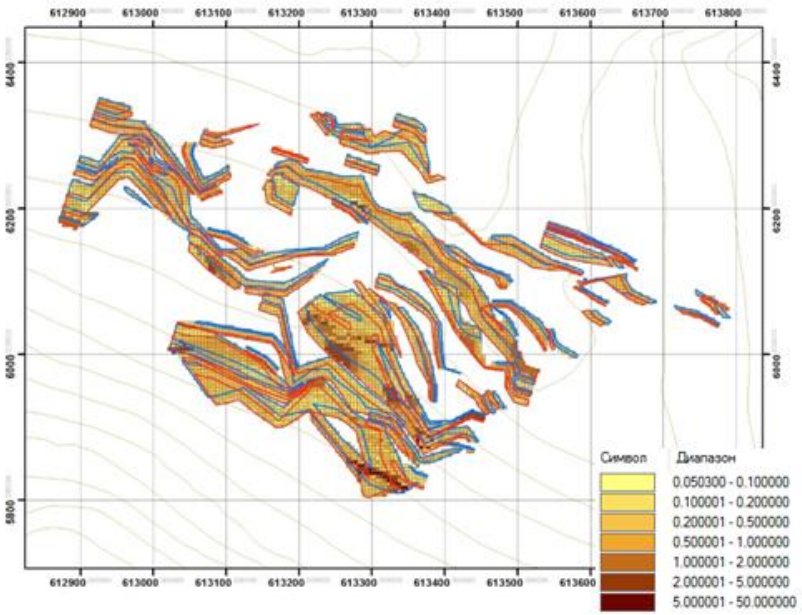


Fig. 3. *Block model of ore body grades*

It should be noted that the carbonate content of rocks, which is the total percentage or mass content of carbonate minerals in the rock, plays an important role in modeling the ore body. The carbonate content of rocks depends on the quantitative content of carbonic acid salts in them, such as limestone ($CaCO_3$), dolomite CaMg $[CO_3]_2$, siderite ($FeCO_3$). In this case, the determination of the total carbonate content is carried out on the core material using laboratory analysis of the content of the elements Ca, Mg, Fe. In the future, it is possible to use regression analysis to obtain a function that performs a more accurate approximation of the calculated carbonate value to the values determined in laboratory conditions:

$$Carb = k1 + k2 \cdot f(C_{Ca}, C_{Mg}, C_{Fe}),$$

where k1, k2 - correction coefficients of the linear regression equation; $f(C_{Ca}, C_{Mg}, C_{Fe})$ – a carbonate function calculated from the content of Ca, Mg, Fe and their mass fraction in the corresponding salts:

$$f(C_{Ca}, C_{Mg}, C_{Fe}) = C_{Ca} \cdot 100/71.4 + C_{Fe} \cdot 100/77.7 + C_{mg} \cdot 100/60.3)$$

The interpolation of the Ca, Fe, Ma grades is performed in a manner similar to the grades model, after which the CARB index is calculated for each block (figure 4).

To obtain a porosity model (POR), it is necessary to build wireframe models of the lithological differences of the field. After that, each block of the ore model is assigned a porosity value in accordance with the value of the lithological difference of this block (table 1, figure 5).

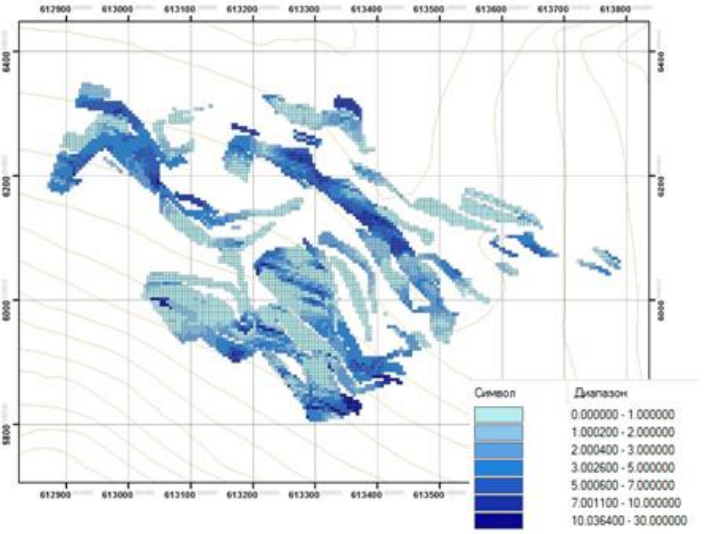


Fig. 4. *Block carbonate model*

Table 1

Physical properties of rocks

Name of the rock	Physical properties		
	density, g/cm ^{3}	porosity, %	water absorption, %
Various-grained sandstones	2.46	3.13	0.5
Diorites	2.67	4.3	0.61
Dacites	2.64	2.2	0.59
Limestone	2.5	5	2.7

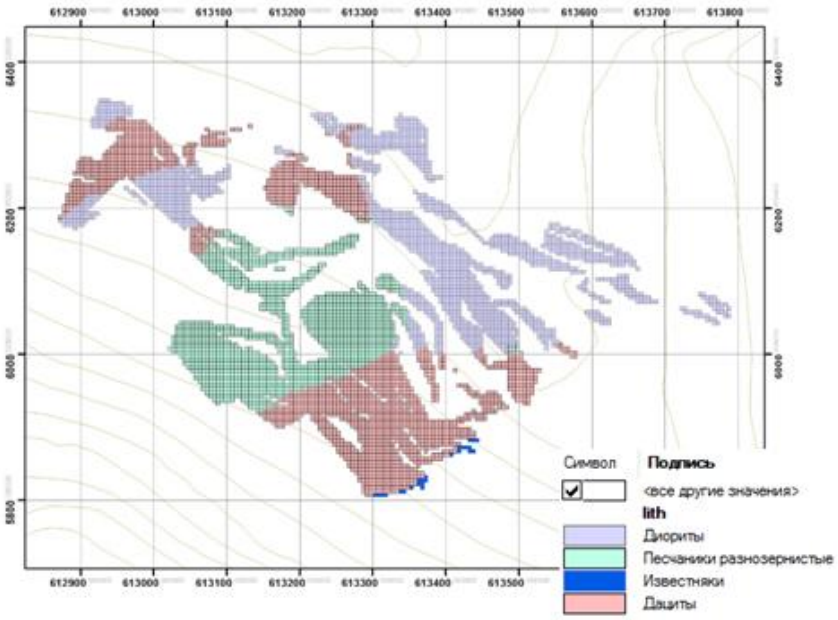


Fig. 5. *Block model of lithological differences*

To build a fracture model (FRAC), the number of fractures is counted with the formation of an interval table with the following fields:

– hole_id – well identifier;

– from, to – sampling interval;

– fraction – fracture category (0 – weak, 1 – medium, 2 – strong).

After the formation of the table, the values at the central points of the intervals are interpolated into the block model in the corresponding attribute (figure 6).

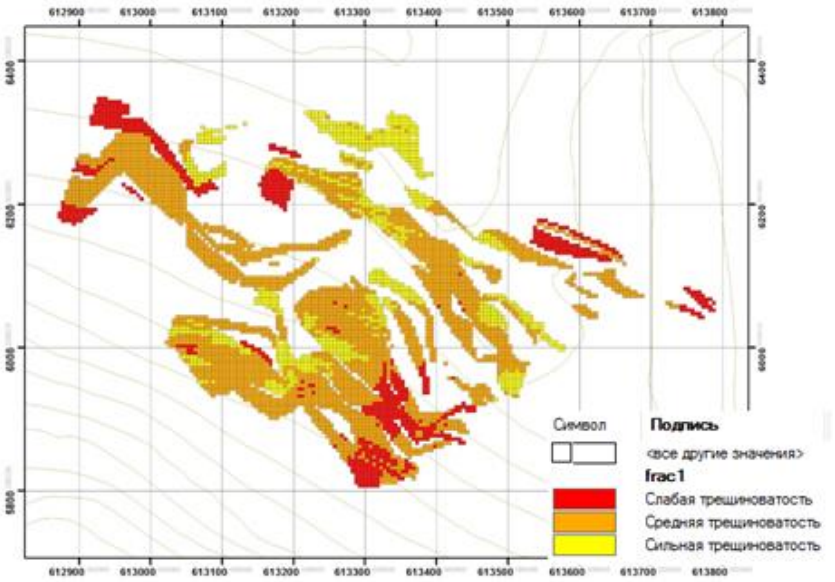


Fig. 6. *Block fracture model*

The construction of a groundwater model (UWLEV) is carried out in several stages:

1) on the basis of data from hydrogeological wells, a triangulation surface of the water ground level is constructed;

2) the classification of blocks of the ore model is carried out: blocks located below the water level are discarded and subsequently do not participate in the formation of the rating model (figure 7);

3) for each of the remaining blocks, the UWLEV value is calculated and entered into the corresponding attribute by the formula: UWLEV = $d_{topo} + d_{UW,}$ where d_{topo} – distance from the center of the block to the topobase at the same values of coordinates x, y;; d_{UW} – the distance from the groundwater level to the topobase at the same values of the x, y coordinates (figure 8). Thus, the mutual influence of the depth of groundwater and the depth of each ore block will be taken into account.

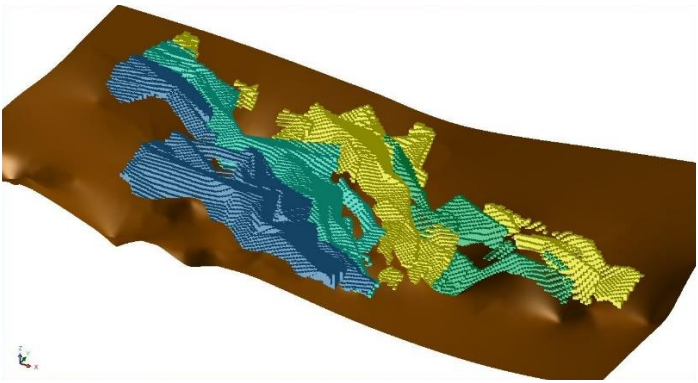


Fig. 7. *Classification of blocks of the ore model (above the water table)*

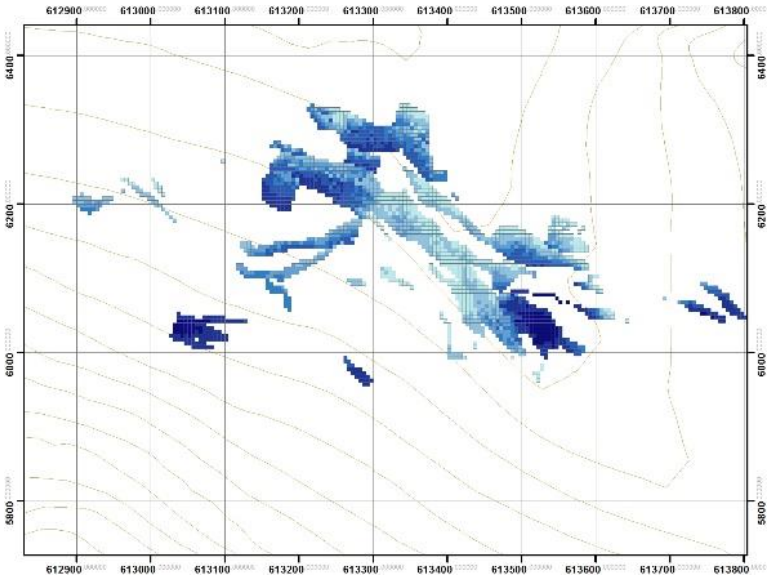


Fig. 8. *Block model of the groundwater level*

The value for each rating block is based on the cumulative contribution of all of the above criteria. As a unit of measurement, it is proposed to use percentages: blocks with a rating of 100% reach maximum values for each of the factors considered. Thus, to calculate the rating, it is necessary for all blocks to determine the parameter value for the most favorable and least favorable outcomes. Then the overall rating of the block can be calculated using the formula:

$$R = \sum_{i=COND,CARB,POR,FRAC,UWLEV} k_i \left(\frac{x_i - min_i}{max_i - min_i} \right)$$

where x – the value of the corresponding criterion in the block (COND, CARB, POR, FRAC, UWLEV); min, max – respectively, the value with the minimum and maximum rating for the corresponding criterion for the entire sample of blocks; k – a weighting factor that takes into account the influence of one factor or another on the final result, $\sum k_i = 100$.

The final rating model for the example under consideration is shown in fig. 9. Zones most preferable for the placement of underground leaching pads are circled in red. The calculated indicators of the model are given in tab. 2.

Table 2

Estimated model parameters

Criterion	Indicators		
	Criterion value with min. rating	Criterion value with max. rating	Weight coefficient
Content	0,0402	7,7433	30
Carbonate index	12,2291	0,002	30
Porosity	2,2	4,3	20
Fracturing	0	2	15
Groundwater level	140,387	42,286	5

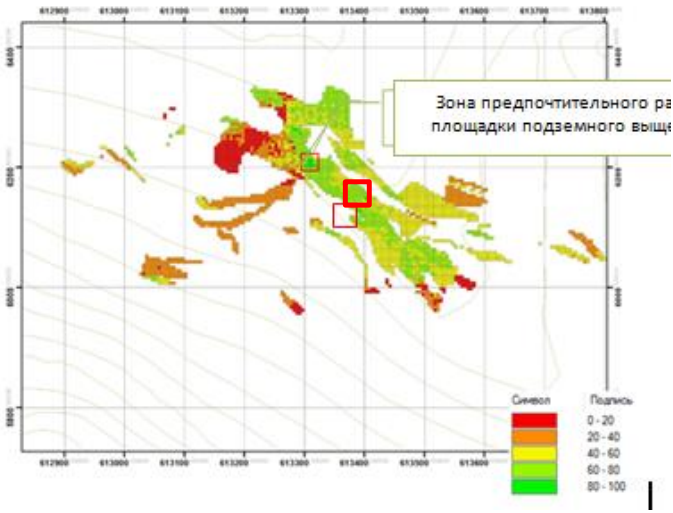


Fig. 9. *Rating block model*

The considered method of choosing the optimal location of underground leaching sites are supposed to be implemented as a separate software package or as a module for popular mining and geological systems. At the same time, a promising task is to implement the possibility of using an arbitrary number of criteria for the rating model and expand the functions used to calculate the values of each rating.

The work was carried out within the framework of the FSR project with the state registration № AAAA-A17-117092750073-6.

References

1. Shek V.M. Object-oriented modeling of mining systems. – Textbook – M.: Publishing house of the Moscow State Mining University, 2000. – 304 P.

2. Vasilyuk P.A., Razmakhnin K.K. Results of hydrometallurgical studies of oxidized gold-bearing ore at the North-Vostochny site of the Delmachik deposit // MIAB. Mining Informational and Analytical Bulletin, 2020;(9), P. 77-86.

3. Kazhdan A.I., Guskov O.I. Mathematical methods in geology. – M.: Bowels, 1990.

4. Chunmiao Zheng, P. Patrick Wang. A Modular Three-Dimensional Multispecies Transport Model for Simulation of Advection, Dispersion, and Chemical Reaction of Contaminants in Groundwater Systems // Department of Geological Sciences, University of Alabama,1999. – 160 P.

DOI 10.34660/INF.2020.20.89.031

北高加索联邦区当前气候变化评估
ASSESSMENT OF CURRENT CLIMATE CHANGE IN THE NORTH CAUCASIAN FEDERAL DISTRICT

Kesheva Lara Asirovna
Candidate of Physics and Mathematics Sciences, Research Officer
High-Mountain Geophysical Institute
Teunova Nataliya Vyacheslavovna
Senior Scientist
High-Mountain Geophysical Institute
Nalchik, Russia

注解。 根据北高加索水文气象与环境监测总局提供的气象参数，分析了一年中最冷的月份（一月），最热的月份（七月）的温度和降水及其平均年值。 在北高加索联邦区。 在整个观测期（1961-2019年）和现代变暖期（1976-2019年）进行了分析。 该分析基于回归分析方法。 获得平均，最高和最低温度的变化率，以及降水量和每日最高值。

关键字。 年平均温度，绝对最大值，绝对最小值，降水量，每日最大值，变化率，趋势，北高加索联邦区。

Annotation. *Based on the meteorological parameters provided by the North Caucasian Directorate for Hydrometeorology and Environmental Monitoring, an analysis was made of temperatures and precipitation in the coldest month of the year (January), the hottest month (July), and their average annual values in the North Caucasian Federal District. The analysis was carried out for the entire observation period (1961-2019) and during the period of modern warming (1976-2019). The analysis is based on the regression analysis method. The rates of change of average, maximum and minimum temperatures, as well as the amount of precipitation and daily maximums were obtained.*

Keywords. *average annual temperatures, absolute maximum, absolute minimum, precipitation amount, daily maximum, rate of change, trend, North Caucasian Federal District.*

Climate change is becoming a global factor that can have a colossal impact on all spheres of human activity and the environment. In the "Assessment Report on Climate Changes and Their Consequences on the Territory of the Russian Fed-

eration ” (2020) [1] notes that this process is not the same in different regions of Russia.

The climate of the North Caucasian Federal District (NCFD) is determined by the peculiarity of the geographic location of the region, the proximity of the Black, Azov and Caspian Seas, the complexity and diversity of the relief. The North Caucasian Federal District is located in the southern part of the European part of Russia, in the lower reaches of the Volga River, in the central and eastern parts of the North Caucasus, from the east the territory of the North Caucasus Federal District is washed by the Caspian Sea. In terms of temperature, the North Caucasian Federal District is one of the most favorable regions of Russia, both in summer and in winter.

By the nature of the relief, the territory of the North Caucasus is usually subdivided into four zones: plain (<500 m above sea level), foothill (500-1000 m above sea level), mountain (> 1000 m above sea level) and high- mountain (> 2000 m above sea level). Each of these territories is characterized by its own temperature regime and amount of precipitation.

To identify the average climatic parameters of the North Caucasus Federal District, 2 months were chosen: January is the coldest month of the cold period, July is the hottest month of the warm period, as well as annual indicators.

Of interest is the assessment of modern climate change since 1976, since this year, on the recommendation of the World Meteorological Organization, is considered the beginning of global warming.

The method of regression analysis was used to obtain the characteristics of changes in the temperature regime: b – the slope, which characterizes the rate of change of the meteorological parameter; D,% – the contribution of the trend to the total variance. Coefficients of linear trends in our study for temperature are expressed in degrees per decade, °C/10 years, for precipitation in mm/month/10 years (hereinafter referred to as mm/10 years).

Comparative estimates of the rate of change in the average surface air temperature of the North Caucasus region for 1976-2019 are shown in Table 1.

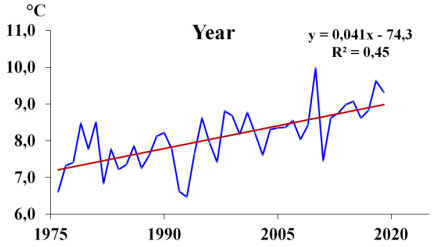
Table 1 – *Comparative estimates of the rate of change in the average surface air temperature of the North Caucasus region for 1976-2019.*

Season	average annual temperature		absolute maximum temperature		absolute minimum temperature	
	b	***D(%)***	***b***	***D(%)***	***b***	***D(%)***
Plain zone						
Junuary	0,31	3,49	0,20	1,19	-0,04	0,0
July	0,48	**26,7**	0,64	**24,44**	0,19	**3,02**
Year	0,46	**47,2**	0,78	**38,57**	0,37	1,43

Foothill zone						
Junuary	0,39	5,49	0,13	0,40	0,29	0,62
July	0,64	**32,4**	0,79	**20,92**	0,44	**16,16**
Year	0,57	**55,1**	0,72	**25,19**	0,51	**3,21**
Mountain zone						
Junuary	0,43	6,33	0,27	1,97	0,5	5,05
July	0,44	**22,3**	0,53	**10,62**	0,35	**8,40**
Year	0,43	**44,0**	0,51	**10,65**	0,61	7,82
The high mountain zone						
Junuary	0,50	0,08	-	-	-	-
July	0,30	11,0	-	-	-	-
Year	0,19	13,6	-	-	-	-
Average values for the North Caucasus region						
Junuary	0,29	3,58	0,20	1,31	0,25	0,67
July	0,47	**24,7**	0,65	**21,04**	0,33	**9,62**
Year	0,41	**45,1**	0,67	**25,97**	0,50	4,33

b – value of the angular coefficient of the linear trend (°C /10 years), D (%) – contribution of the trend to the total variance. Bold indicates trends that are statistically significant at the 5% level.

During the studied period 1976-2019, there was a further statistically significant increase in average annual temperatures at a rate of 0,41°C/10 years with a contribution to the total variance of D=45,1%; in July, the rate of temperature change was 0,47°C/10 years (D=24,7%); in January, there was a statistically insignificant increase in temperature by 0,29°C/10 years (D=3,58%). The absolute maximum temperature (in the year as a whole) increased by 0,67°C/10 years (D=25,97%), for the month of July by 0,65°C/10 years (D=21,04%), both trends are statistically significant, in contrast to the trend in January (0,20°C/10 years, D=1,31%). In July, there was a statistically insignificant increase in absolute temperature minima at a rate of 0,33°C/10 years (D=9,62%) (table 1, Fig. 1). The largest contribution of the trend to the explained variance is due to an increase in summer (July) absolute temperature minima (Fig. 1).



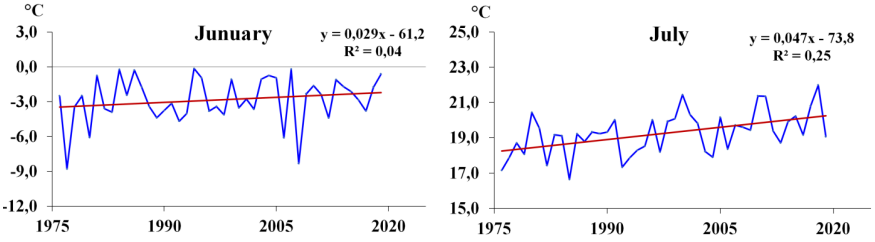
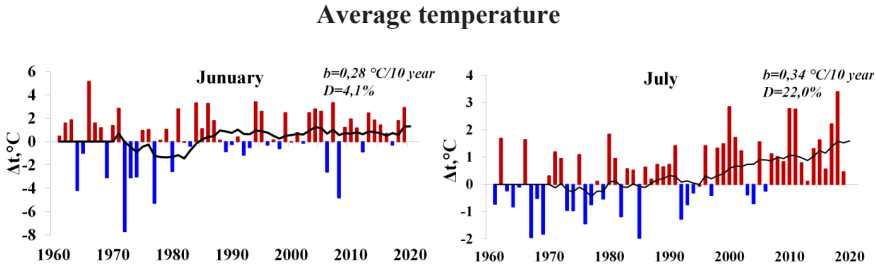


***Figure 1** – Average temperatures with trends, 1976-2019, North Caucasus Federal District*

The course of the average monthly (January, July) temperature anomalies averaged over the NCFD for the period 1961-219 is shown in figure 2. Anomalies are calculated as deviations from the average for 1961-1990. The smoothed curve is obtained by an 11-year moving average. Figure 2 shows that since the mid-90s, the number of positive anomalies has been higher than the number of negative ones. This suggests that warming continues both in the warm period and in the cold.

Figure 2 shows that there is a tendency for the average temperature in July to increase at a rate of 0.34 ° C / 10 years, the contribution of the trend to the total variance was 22.0%. The absolute maximum temperature for the same month tends to increase slightly at a rate of 0.28 ° C and a contribution to the total variance of 7.1%. Minimum temperatures also tend to increase slightly at a rate of 0.2 ° C / 10years (D = 7.5%).

In January, there are small fluctuations in the average temperature, but in General, in the period 1961-2019, there is a slight increase in its rate of 0,28°C/10 years at D=4,1%. Maximum and minimum January temperatures are increasing at a rate of 0,2°C/10 years and 0,25°C/10 years, respectively.



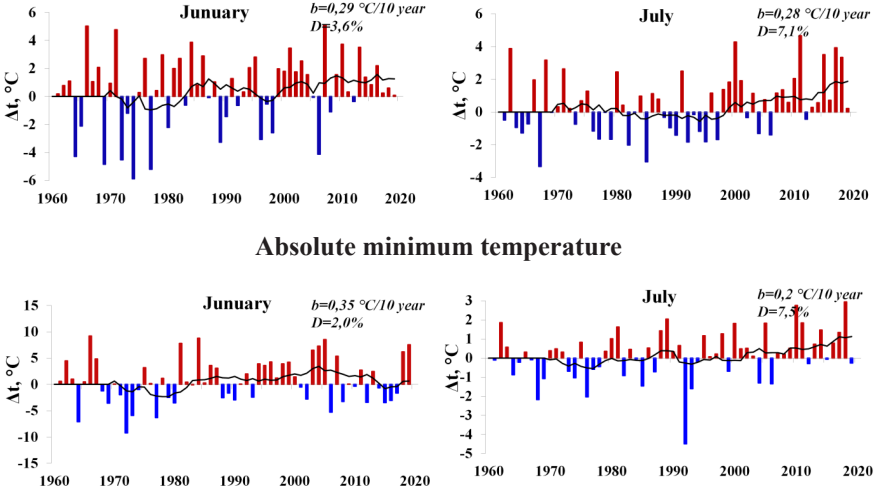


Figure 2 - *Monthly average temperature anomalies (°C) in the North Caucasus Federal district (deviations from the average values for 1961-1990)*

Changes in the precipitation regime are not as obvious as changes in the temperature regime. For all m/stations, both an increase and a decrease in seasonal precipitation amounts were observed. The growth rate of the average annual precipitation in the North Caucasus Federal district for the period from 1976 to 2019 was 5,31 mm/10 years, the trend is statistically insignificant (D=1,29%). In all zones, with the exception of high-mountain, there is a statistically insignificant decrease in the amount of precipitation in the summer season (July), the amount of precipitation in January has a statistically significant tendency to increase only in the lowland zone (3,13 mm/10 years (D=10,02%)) (table 2, Fig. 3). In the high-mountain zone, there was a statistically insignificant decrease in the amount of precipitation in January, while the amount of precipitation in July had a statistically insignificant positive trend.

Table 2 – *Comparative estimates of the rate of change in precipitation in the North Caucasus region for 1976-2019.*

Season	total precipitation		maximum precipitation	
	b	***D(%)***	***b***	***D(%)***
Plain zone				
Junuary	3,13	**10,02**	0,57	6,73
July	-1,49	1,06	-0,09	0,02
Year	5,32	1,12	1,10	0,16

Foothill zone				
Junuary	1,45	3,19	0,31	1,75
July	-2,31	0,81	-0,32	0,24
Year	0,73	0,01	-0,23	0,15
Mountain zone				
Junuary	0,18	0,0	-0,70	1,10
July	-1,46	0,60	-0,56	0,63
Year	-0,08	0,0	0,72	0,91
The high mountain zone				
Junuary	-2,73	0,41	-	-
July	2,90	0,82	-	-
Year	15,25	1,36	-	-
Average values for the North Caucasus region				
Junuary	0,51	0,08	0,06	0,04
July	-0,6	0,11	-0,32	0,38
Year	5,31	1,29	0,53	1,31

b – value of the angular coefficient of the linear trend (°C /10 years), D (%) – contribution of the trend to the total variance. Bold indicates trends that are statistically significant at the 5% level.

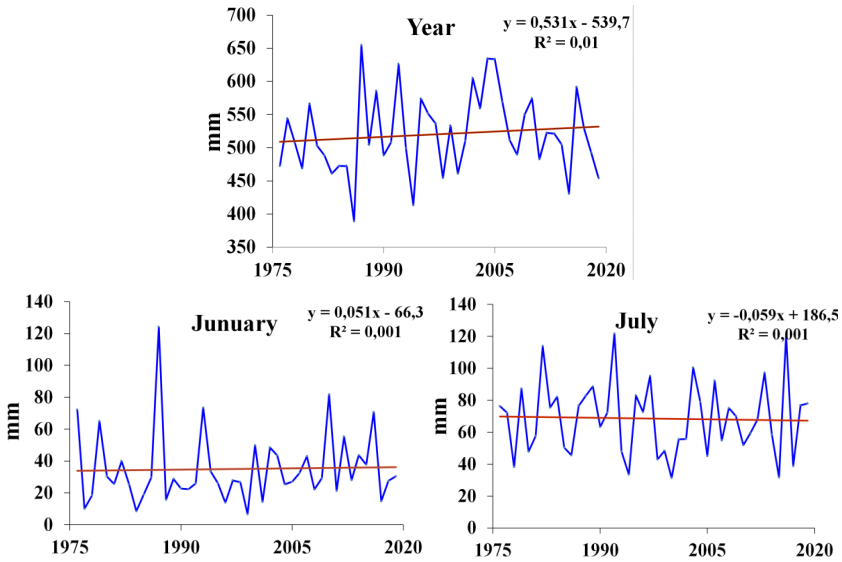


***Figure 3** – Average precipitation with trends, 1976-2019, North Caucasus Federal District*

Figure 4 shows the average precipitation anomalies (mm/month), averaged over the North Caucasus Federal District for the period 1961-2019.

Figure 4 shows that the amount of precipitation in July had a statistically insignificant tendency to decrease at a rate of -1,0 mm over 10 years and 0,0% contributed to the total variance. The maximum precipitation also had a statistically insignificant tendency to decrease at a rate of 0,003 mm over 10 years. In January, the amount of precipitation and maximum precipitation also have a statistically insignificant increase at a rate of 0,14 mm and 0,2 mm over 10 years, respectively.

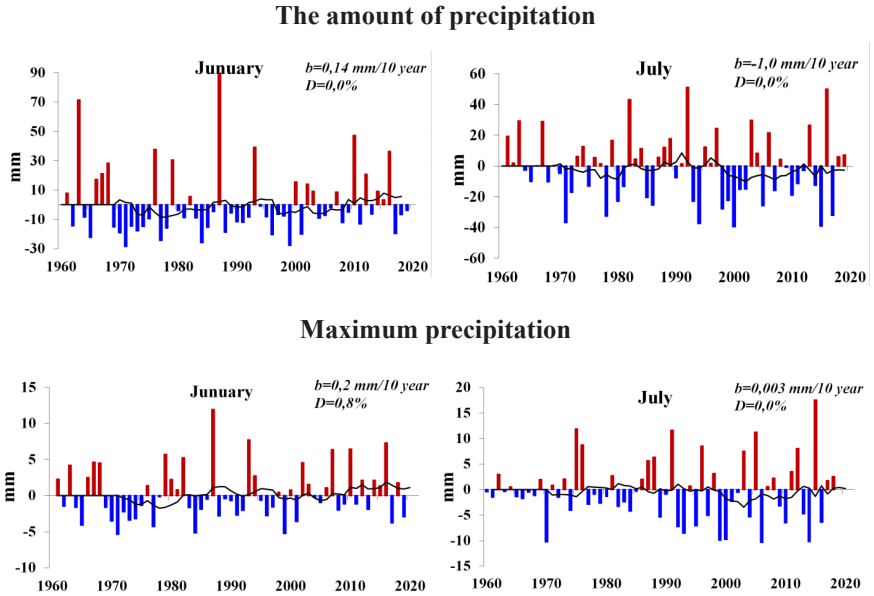


Figure 4 – *Average monthly precipitation anomalies (mm) on the territory of the North Caucasus Federal district (deviations from the average values for 1961-1990)*

The analysis of the temperature showed that in general for the North Caucasus region in the period 1976-2019. there was a statistically significant increase in average annual temperatures and average temperatures in July, as well as absolute maximums. January temperatures show a statistically insignificant increase. The growth rate of average annual temperatures in the period 1976-2019 increased compared to the entire observation period (1961-2019). Changes in precipitation are not as obvious as changes in temperature. Both an increase and a decrease in seasonal precipitation were observed.

Throughout the North Caucasus region from 1976 to 2019, there was a statistically insignificant increase in annual precipitation amounts and daily maximum precipitation. July precipitation has a statistically insignificant negative trend.

References

1. Report on the peculiarities of the climate in the territory of the Russian Federation for 2019. Roshydromet. Moscow, 2020 . – 97 p.

2. https: //krskfo.ru/o-regione/geografiya/

3. Ashabokov BA, Tashilova AA, Kesheva LA, Taubekova ZA Trends in precipitation regime and frequency of extreme values in different climatic zones of southern Russia (1961-2011) Meteorology and hydrology. No. 3, 2017, Pp. 18–28.

4. Ashabokov BA, Tashilova AA, Kesheva LA, Teunova NV, Taubekova ZA Climatic changes in mean values and extremes of near-surface air temperature in the south of the European territory of Russia. Fundamental and Applied Climatology. No. 1, 2017. Pp. 5-19.

5. Ashabokov B. A., Fedchenko L. M., Tashilova A. A., Kesheva L. A., Teunova N. V. Spatio-temporal climate change in the south of the European territory of Russia, assessment of its consequences, methods and models of agro-industrial complex adaptation. Monograph, LLC "Fregat", 2020, 476 p.

DOI 10.34660/INF.2020.20.40.032

萨哈共和国（雅库特）的工程地质学地带划分方法
APPROACHES TO ENGINEERING GEOCRYOLOGICAL ZONATION OF THE REPUBLIC OF SAKHA (YAKUTIA)

Shestakova Alyona Alexeevna
Candidate of Geographic Sciences, Researcher
Melnikov Permafrost Institute of Siberian Branch
of the Russian Academy of Sciences

抽象。本文描述了萨哈共和国（雅库特）的工程地质学分区，该分区是在分析主要控制因素及其制图概括的基础上进行的。编制了一些示意图，描绘了地形（地形），地质过程，土壤和岩石，多年冻土条件和地震活动。对工程地质条件的类型进行了评估，并根据工程的适用性对区域进行评分。本文从简短的导言开始，阐明了研究的目的和重要性。　“方法”部分描述了为方便分区而采用的控制因子的排名。下一部分将讨论控制萨哈（雅库特）工程地质条件的因素。结果和讨论部分描述了生成的一系列地图，包括：形态结构分区图，地学过程强度分区图，地面和多年冻土条件分区图，地震分区图。它还对控制因素进行了综合分析，并得出结论，沿海低地和浅海架地区对工程设计最具挑战性。为了进一步完善工程条件，似乎建议准备多年冻土-地形图，地貌图和其他区域地图，这对于评估萨哈共和国（雅库特）预计发展的经济可行性很有用。

关键词：分区，工程地质条件，地质过程，地面条件，形态结构，多年冻土条件，气候变化。

Abstract. *This paper describes the engineering geocryological zoning of the Republic of Sakha (Yakutia) which was performed based on analysis of the main controlling factors and their cartographic generalization. Several schematic maps were compiled depicting topography (landforms), geocryological processes, soils and rocks, permafrost conditions and seismicity. The types of engineering geocryological conditions were assessed and scored to classify areas by suitability for engineering. The paper begins with a brief Introduction which clarifies the objectives and importance of the research. The Methods section describes the ranking of control factors adopted for the convenience of zonation. The next section discusses the factors controlling engineering geocryological conditions in Sakha (Yakutia). The Results and Discussion section describes the series of maps produced comprising: a map of morphostructural zonation, a zonation map*

of geocryological processes intensity, a zonation map of ground and permafrost conditions, a map of seismic zonation. It also presents an integrated analysis of the controlling factors and concludes that the Coastal Lowlands and Shallow Seashelf Region is most challenging for engineering. For further refinement of engineering conditions, it seems advisable to prepare permafrost-landscape, geomorphological and other regional maps that would be useful for assessing economic feasibility of projected developments in the Republic of Sakha (Yakutia).

Keywords: *zonation, engineering-geocryological conditions, geocryological processes, ground conditions, morphostructure, permafrost conditions, climate change.*

Introduction

Engineering geocryological zonation is a method used in engineering geocryology which deals with the geological environment of engineering structures in permafrost areas. The engineering geocryological conditions are controlled by the properties of frozen and thawing materials, permafrost-related geological processes, condition of intra- and subpermafrost aquifers, and rapid temporal variability of ground temperature distribution [1]. The purpose of the engineering geocryological zonation of the Republic of Sakha (Yakutia) is to provide background information for the planning of land-use, selection of transportation and communication alignments, and feasibility evaluation of proposed developments, as well as for the assessment of geological hazards for mitigation and prevention. This study is particularly important and necessary in view of accelerated development of northern areas, including the Arctic. Analysis of engineering-geocryological conditions involves the upper 10-20 m layer within which permafrost can influence or be influenced by the existing or new engineering work in Sakha (Yakutia). This depth coincides with the depth of annual temperature variation in the study region.

Methods

For the convenience of zonation, the types of engineering-geocryological conditions were ranked. The highest classification taxon, the Region, was assigned to major landforms. The second rank unit - the Province - was allotted to smaller landforms and associated geocryological processes. The third, lower taxonomic level – the Area – was used to depict the soil and rock units. The District taxon was used to show the geocryological characteristics of soils and rocks. Hydrogeological conditions and seismicity were depicted on inset maps, outside the ranking system.

Factors controlling engineering geocryological conditions in the Republic of Sakha (Yakutia)

Popov [2, p. 8] states that characterization and evaluation of engineering geological conditions for construction should highlight: a) structure and constituents of the earth's crust; b) structure of the earth crust surface; c) ground water; and

d) modern geological processes. Trofimov [3] writes that engineering geological conditions are usually considered as a set of modern geological characteristics (parameters and factors) that determine the conditions for engineering site investigations, as well as for construction, operation and maintenance of engineering structures (narrow approach), or the conditions for engineering-related economic activity in general (broad approach). According to Trofimov and Averkina [4], engineering geological (geocryological) conditions comprise the following components: 1) the geological structure of an area and the nature of constituent rocks; 2) relief; 3) hydrogeological conditions; 4) permafrost conditions; and 5) modern geological processes. Trofimov [5, p. 34] redefines I.V. Popov's law of regional engineering geology as follows: "The modern features of the Earth's engineering geological structures are determined by their geological history, the present-day structural and tectonic setting, and current climatic conditions, as well as the character of human impacts in land-use areas". The structural zones control a set of specific formations characterized by the features of magmatism, hydrogeological conditions and modern geological processes [6, 7]. The geodynamic factor determines the spatial distribution of the main *morphostructural elements:* lowland, plateau and mountain regions. The present-day geodynamics of Sakha (Yakutia) is controlled by the current boundaries of the Eurasian and North American plates in the eastern half of the area [8] and the Baikal-Stanovoy Fold-and-Thrust Belt in the south [9]. The morphostructural factor controls the intensity and types of exogeneous processes, as well as the ground conditions. It is this factor that determines the degree of difficulty for construction and operation of engineering works. The geocryological factor exerts a direct effect on the geological medium, especially on the ground conditions [1]. The hydrogeological factor depends to a large degree on geocryological conditions. The map area is mostly underlain by continuous permafrost and the dominant water type is ultra-fresh water of the active layer. Seismicity is closely related to the geodynamic factor and the zonal climate which control the periglacial areas of active glacial isostatic movement. All the factors are interrelated and affect determine the entire complex of engineering geocryological conditions.

Results and discussion

Morphostructural (geomorphological) zonation. Considering its size, morphostructures (regions) were adopted by the authors as first-order taxonomic units. Five regions were recognized within the map area [10]: a) Coastal Plains/Lowlands and Shallow Seashelf Region [9, p. 12-18, 11, 12]; b) Central Siberian Plains and Plateaus Region; c) Baikal-Stanovoy Region; d) Verkhoyansk-Chukotka Region; and e) Trans-Regional Areasinclude valleys of the major rivers (Lena, Indigirka, and Kolyma). The proposed classification is close to the one presented in Ershov [1]. Based on surface elevation, size and spatial position of the morphostructures,

as well as their landscape characteristics, the regions were subdivided into smaller taxonomic units - provinces. In total, about 90 provinces were recognized. The table 1 presents numerical scores indicating the relative difficulty for engineering (other things being equal) in relation to relief complexity in the main types of morphostructural regions and provinces.

Table 1. *Morphostructural province types*

Landforms and their origin	Plains	Plateaus	Mountains
Aggradation (alluvial, fluvioglacial)	Low - 4	-	-
Denudation and aggradation	Middle and elevated - 3	-	-
Denudation and aggradation	High - 1	-	-
Denudation	-	Low - 4	Low - 7,8
	-	Middle - 5	Middle - 9,10
	-	High - 6	High - 10-12

Zonation by intensity of geocryological processes. To illustrate the characterization of geocryological processes, table 2 presents a part of the table compiled for the entire area of Yakutia. Geocryological processes are classified in terms of hazard level into: Class 1 - very low, Class 2 - low, Class 3 - moderate, Class 4 - high, and Class 5 - very high [1]. A procedure described in Ershov [1, table 5.3, p. 188] was adopted for areal process intensity classification. Abbreviations used to denote geocryological processes are: T - thermokarst, H - frost heaving, I - relative icing coverage, S - solifluction, E - earth flow, Te - thermal erosion, Ta - thermal abrasion.

Table 2. *A part of the table describing morphostructural zones and associated geocryological processes.*

Morphostructural zonation units	Intensity score of geocryological processes	Zonal-sectorial landscape type	Set of processes and their intensity score
Coastal Plains/Lowlands and Shallow Seashelf Region Provinces:		Arctic and Subarctic	
I-1. Anjou and De Long Islands	5	mm-m[a]	$Ta_{4-5}E_{3-4}Te_{3-4}T_2H_2$
I-2. Lyakhovsky Islands	5	mm-m	$Ta_{4-5}E_{3-4}Te_{3-4}T_2H_2$

I-3. Bolshoy Begichev Island	4	mm-m	$Ta_{3-4}T_{3-4}Te_{3-4}$
I-4. Mamontov Klyk Peninsula	5	mm-m	$H_{2-3}E_{2-3}S_2$ $Ta_{3-4}T_{3-4}Te_{3-4}$ $H_{2-3}E_{2-3}S_2$

[a] Letter symbols after Ershov [1, Table 5.2, pp. 183-187]: mm - moderately maritime, mc – moderately continental, c – continental, sc – strongly continental.

Zonation by ground conditions. The rank of ground taxons was limited to soils/rock class and group [13] (table 3). Additionally, transitional groups were recognized, including combinations of carbonate and terrigenous rocks, combinations of soils and semi-solid rocks, and two-layer sections [14].

Table 3. *Elements of the ground component of engineering geocryological zonation.*

Frozen and cryotic rock class	Group	Type and variety groups
Solid rocks	Siliceous	Intrusive rocks of all groups, extrusive traps, metamorphic rocks -1
	Carbonaceous, karstified	Limestones, dolomites - 2
Semi-solid rocks	Combination of solid and semi-solid rocks	Combination of carbonaceous and terrigeneous rocks: limestones, marls, dolomites, interlayers of argillite, siltstone, sandstone and conglomerate – 2
	Volcanic	Tuff and lava – 1
	Terrigeneous	Interbedded sandstones, siltstones and argillites, coal seams, vulcanite and conglomerate interlayers - 1
Solid and semi-solid rocks with soluble rock interlayers		Terrigeneous and carbonaceous rocks with interlayers of gypsum, dolomite, anhydrate and salt – 6

Zonation by permafrost conditions. The ground temperature range between 0 and -2°C is used as an attribute to identify permafrost conditions for construction purposes. This temperature range controls the plastic properties of frozen soils, determining if the soil is in a solid frozen or plastic frozen state (table 4). Estimated complication of engineering geological conditions in relation to ice content and temperature is given in brackets.

Table 4. *Characterization of permafrost conditions*

Material	Ground temperature, °C	Condition	Ice content		
			Low	Medium	High
Soils	Below -2°	solid-frozen	A(1)	B(2)	C(4)
		plastic-frozen	D(2)	E(3)	F(5)
Rocks	Below -0°	dry	G(4)		
		frozen	H(0)	I(1)	J(2)
	Above 0°C	unfrozen	K(1)		

Hydrogeological zonation is based on the type and aggressiveness of intra- and suprapermafrost water. Suprapermafrost water in the map area is mostly calcium bicarbonate type and is not chemically aggressive [15, 16, 17, 18, 19]. Mineralized water springs with dissolved-solids concentrations averaging 4 g/l occur in the Baikal-Stanovoy Region. They are confined to areas of discontinuous and sporadic permafrost and contain elevated sulfate levels (table 5).

Table 5. *Characteristics of hydrogeological conditions*

Permafrost type	Depth to suprapermafrost water and groundwater	Predominant aggressive agent in groundwater	Engineering complication score
Continuous	<3 m, >3 m in fault zones	Non-aggressive	1
		Acids + pH	1
	<3 m and <10 m in intrapermafrost taliks	Non-aggressive	1
		Acids + pH	2
		Acids + sulfates	3
	3-10 m, occasionally >10 m	Sulfates (in the transition zone)	3
		pH (periglacial dunefields)	3
Discontinuous	3-10 m, occasionally >10 m	Non-aggressive	1
		Sulfates	3
Sporadic	>10 m	Sulfates	3

Seismic Zonation was differentiated based on earthquake intensity. About half of the area lies in the zones with intensity of 6 or higher. Earthquakes with intensity of 5 can occur in other parts of Yakutia (table 6).

Table 6. *Predominant earthquake intensity in the engineering geocryological regions, Sakha (Yakutia).*

Region	Earthquake intensity	Estimated score for the region
I. Coastal Plains/Lowlands and Shallow Seashelf	9-5	9
II. Central Siberian Plains and Plateaus	5	5
III. Baikal-Stanovoy Fold-and-Thrust Belt	9-6	9
IV. Verkhoyansk-Chukotka Region	9-7	9
V. Trans-Regional Areas - major river valleys	6-7	7

Integrated Analysis of Engineering Geocryological Factors. As an example, table 7 presents a comparative assessment at the scale of region, the largest zonation unit. A conventional approach to evaluating engineering conditions for permafrost areas well described in the literature [1, 20] has been adopted. It should be noted that these estimates provide a very first approximation and do not take into account the economic importance of the regions.

Table 7. *Comparative assessment of the mapped regions in terms of difficulty for engineering.*

Region	Engineering difficulty score						
	Topography	Geocryological processes	Ground conditions	Permafrost conditions	Hydrogeological conditions	Seismic conditions	Total score
I. Coastal Lowlands and Shallow Seashelf	4	5	10	4	1	9	33
II. Central Siberian Plains and Plateaus	3	3	6	4	3	5	24
III. Baikal-Stanovoy Fold-and-Thrust Belt	9	2	6	4	3	9	33
IV. Verkhoyansk-Chukotka Region	12	4	2	1	1	9	29
V. Trans-Regional Areas - major river valleys	4	3	7	1	1	7	23

Conclusions

As is seen from the above Table, the major river valleys (score 23) and the Central Siberian Plains and Plateaus (central Yakutia) (score 24) have the most favorable engineering geocryological conditions. The worst conditions for engineering activities exist in the Coastal Plains/Lowlands and Shallow Seashelf Region, as well as in the Baikal-Stanovoy Belt (score 33). Its land area is dominated by very ice-rich permafrost with a complexity score of 10 points. High seismicity is mostly characteristic of the Laptev Sea area. Thermokarst processes present the most serious danger. The average rate of thermokarst (0.5-2 m/a) can be inferred from size of the largest thaw features (5-20 km) and length of the Holocene Optimum (10,000 years) which followed the Sartan Glaciation. However, actual present-day rates can be significantly higher due to positive feedbacks between surface are temperature and thermokarst. In some years, thermal abrasion rates as high as several tens of meters have been reported for the region. The factor of endogenous relief dynamics also needs to be verified by further research. For example, repeated geodetic measurements by Bocharov et al. [12] indicate that the Laptev Sea coast is experiencing glacial isostatic uplift. Consideration of these phenomena would add to the rated engineering complexity for the Coastal Lowlands.

References

1. Ershov E.D. Fundamentals of Geocryology. Part 5: Permafrost Engineering. - Moscow: Moscow State University Press, 1999.

2. Popov V.I. Engineering Geology of the USSR. Part I. - Moscow: Moscow State University Press, 1961.

3. Trofimov V.T. Zonality of Engineering Geological Conditions of the Continents of the Earth. - Moscow: Moscow State University Press, 2002.

4. Trofimov V.T., Averkina T.I. Theoretical Foundations of Regional Engineering Geology. - Moscow: GEOS, 2007.

5. Trofimov V.T. Basic laws of engineering geology and its scientific directions. Theoretical Problems of Engineering Geology. - Moscow: Moscow State University,1999. – pp. 30-34.

6. Chapovsky E.G. Engineering Geology of the USSR. Vol. 4. Far East. - Moscow: Moscow University Press, 1977.

7. Trofimov V.T., Voznesensky E.A., Korolev V.A. Engineering Geology of the Russian Federation. Vol. 1. - Moscow: KDU, 2011.

8. Parfenov L.M., Prokop'ev A.V., Spector V.B. Russian Geology and Geophysics, 2001. - vol 42, pp. 708-725.

9. Parfenov L.M. Tectonics, Geodynamics and Metallogeny of the Republic of Sakha (Yakutia), 2001. - Moscow: MAIK Nauka/Interperiodika.

10. Gerasimov I.P. Novosti Akademii nauk SSSR. Geograficheskaya seriya, 1946, pp. 7-14.

11. Spektor V.B. Geology of the Yakut ASSR. - Moscow: Nedra, 1981.

12. Bocharov G.V., Gusev G.S., Evsikova L.V., Spektor V.B. Geotektonika, 1982, pp. 60-64.

13. Trofimov V.T., Korolev V.A., Voznesensky E.A. Gruntovedeniye. - Moscow: Moscow University Press, 2005.

14. Modern Engineering Geological Map of the Russian Federation. Scale 1: 2500000 / ed. Krupoderov V.S., Chekrygina S.N. and others / Moscow: VSEGINGEO, Rosgeolfondy, 2011.

15. Hydrogeological Map of the Yakut ASSR. Scale 1: 2500000 / ed. Efimov A.I., Zaitsev I.K. / Yakutsk: Permafrost Institute SB USSR Academy of Sciences, Yakutsk State University Press, 1967.

16. Hydrogeological Map of the USSR. Scale 1:2500000 / ed Zhiv D.I. / Moscow: GUGK, 1969.

17. Permafrost and Groundwater Zonation Map of East Siberia. Scale 1: 2500000 / ed. Melnikov P.I. / Yakutsk: Permafrost Institute SB USSR Academy of Sciences, 1980.

18. Suprapermafrost Waters Map of the Republic of Sakha (Yakutia). Scale 1: 2500000 / ed. Melnikov P.I. / Yakutsk: Aerogeodezicheskoe predpriyatie, 1993.

19. Shepelev V.V. Suprapermafrost waters of the cryolithozone. - Novosibirsk: Geo, 2011.

20. Ospennikov E.N., Trush N.I., Chizhov A.B., Chizhova N.I. Exogenous Geological Processes and Features (Southern Yakutia). - Moscow: Moscow University Press, 1980.

UDC 551.583
DOI 10.34660/INF.2020.59.62.033

过去60年俄罗斯南部季节性降水的回归分析结果
RESULTS OF REGRESSION ANALYSIS OF SEASONAL PRECIPITATION IN SOUTHERN RUSSIA OVER THE PAST 60 YEARS

Tashilova Alla Amarbievna
Candidate of Physical and mathematical Sciences, Associate Professor, Senior Researcher
High-Mountain Geophysical Institut
Nalchik, Russia

抽象。本文介绍了分析俄罗斯南部各个气候区的大气降水状况变化的结果。该研究结果基于对降水序列的回归分析，该回归分析是基于1961年至2018年俄罗斯南部20个气象站的仪器观测结果而得出的。为了研究降水状况，使用了“基本三合一”方法：总降水量，每日最大降水量和至少20 mm（NR20）的降水天数。研究发现，在过去的60年中，俄罗斯南部所有气候区的气象站数量都有所增加（从气象站数量的70％到85％）和减少（从气象站数量的30％到15％）。气象站的数量）季节性降水，每日最大降水以及至少20 mm降水的天数。基本上，这些趋势在统计上是微不足道的。在季节性降水的所有变化中，降水量有统计上的显着增加趋势，速率为5.6毫米/月/年，日最大值增加1.0毫米/月/年，NR20增长0.2天/月/年。在5％的水平上，通过标准稳定性和统计学显着性进行了确认（Fisher检验）。

关键词：俄罗斯南部，气候区，降水量，日最大降水量，至少20 mm降水的天数，回归，线性趋势。

Abstract. *The paper presents the results of the analysis of changes in the atmospheric precipitation regime in various climatic zones of the southern Russia. The results of the study are based on a regression analysis of precipitation series based on instrumental observations of twenty meteorological stations in southern Russia in the period from 1961 to 2018. To study the precipitation regime, a “basic triad” was used: the sum precipitation, the daily maximum precipitation and the number of days with precipitation of at least 20 mm (NR20). It was found that over the past 60 years in the south of Russia in all climatic zones there has been both an increase (from 70% to 85% of the number of weather stations) and a decrease (from 30% to 15% of the number of weather stations) of seasonal precipitation , daily maximum precipitation and the number of days with precipitation of at least 20 mm. Basically, these trends are statistically insignificant. Of all the changes in*

seasonal precipitation, there are tendencies of a statistically significant increase in precipitation amounts at a rate of 5.6 mm / month/yrs, daily maximums by 1.0 mm/month/yrs and NR20 by 0.2 days/month/yrs in the autumn season, which are confirmed by the criteria stability and statistical significance at the 5% level (Fisher's test).

Key words: *southern Russia, climatic zones, precipitation amounts, daily maximum precipitation, number of days with precipitation of at least 20 mm, regression, linear trend.*

1. Introduction

Climate change has now become a factor that has a significant impact on atmospheric processes and, thus, on the natural and climatic characteristics of almost all regions of our planet. This can also explain the fact that the study of changes in the natural and climatic characteristics of regions became at different times scientific problems that attracted and attract much attention of researchers [1-6]. The distribution of precipitation in the world is changing in accordance with global climate changes. According to the Intergovernmental Panel on Climate Change (IPCC, 2014), an increase in global average temperature is likely to lead to changes in humidity and precipitation, including a shift towards more extreme precipitation during storms [7]. In the lower atmosphere (troposphere) it becomes warmer, the rate of evaporation increases, which leads to an increase in the amount of circulating moisture. With increasing moisture content in the troposphere, more intense precipitation falls, which can lead to severe flooding.

2. Materials and methods

This work analyzes the changes in atmospheric precipitation in the south of the European territory of Russia (ETR), which was started by the authors in previous studies [8,9]. The sets of meteorological parameters, the so-called basic triad (sum precipitation, daily maximum precipitation and number of days with precipitation of at least 20 mm (*NR20*)), according to data from 20 weather/stations of different climatic zones of the southern Russia were provided by the Hydrometeorology Service North Caucasus Administration.

The time series were investigated by statistical methods, as well as by means of the SPSS 21.0 program [10,11] and supplemented with linear trends characterizing the trend of the considered value for the period of observations from 1961 to 2018. Linear trend ratios were estimated as required by the standard linear regression theory (least squares method) and expressed in mm/month/10yrs or in days/month/10yrs .

To accept the hypothesis of the presence of a statistically significant linear trend, a 95% significance level was adopted and determined through a determination coefficient characterizing the share of the trend in the explained variance (*D*,%).

The proportion of variance due to regression in the total variance of the indicator y is characterized by the coefficient of determination R^2 (or $D = R^2 \cdot 100\%$):

$$R^2 = 1 - \frac{\sum(\hat{y}-\bar{y})^2}{\sum(y-\hat{y})^2}, \quad (1)$$

where $\sum(\hat{y} - \bar{y})^2$ – regression sum of squares; $\sum(y - \hat{y})^2$ – residual sum of squares of deviations.

Using Fisher's criterion, the quality of the regression model is assessed in general and by parameters. To test the hypothesis about the significance of the coefficient of determination (trend), the Fisher criterion (F-test) is calculated using the formula:

$$F = \frac{R^2}{1-R^2} \cdot \frac{n-k-1}{k}, \quad (2)$$

where R^2 – coefficient of determination, n – number of observations, k – number of independent linear regression parameters. The number of degrees of freedom is determined using the expression $df = n - k - 1$.

The lower threshold of the value of the coefficient of determination, which determines the statistical significance of the trend at a 95% confidence interval (Sig.<0.05) was $D = 6.5\%$ (for degrees of freedom $n = 56$).

3. Analysis and Results

Table 1 shows weather stations of various climatic zones of southern Russia, divided into groups according to their height above sea level (m a.s.l.), with annual precipitation averaged over the period 1961-2018 for each weather stations :

- stations located in the Caspian zone: Izberg, Kizlyar, Makhachkala, Derbent. Annual precipitation ranges from 280 to 392 mm.

- stations located in the steppe zone of southern Russia: Mozdok, Prokhladnaya, Rostov-on-Don, Izobilny, Krasnodar, Maykop. Annual precipitation amounts vary from 473 mm to 810 mm.

- station located on the Black Sea coast (Sochi) with the highest total annual precipitation among all studied stations in the south of the EPR - 1636 mm.

- foothill, mountain, alpine weather stations (Buinaksk, Stavropol, Cherkessk, Nalchik, Kislovodsk, Vladikavkaz, Akhty, Teberda and Terskol) with an annual sum precipitation in the range of 406-936 mm. According to the characteristics of the total amount of precipitation in general for the year in the weather stations grouped by climatic zones (altitude), two stations are distinguished: Akhty (1054 m a.s.l., 41.28 °N; 47.44 °E) and Buinaksk (560 m a.s.l., 42.49°N; 47.07°E), located in the easternmost regions of southern Russia (Caspian zone), and, as a consequence, having a characteristic low precipitation amount for the Caspian zone - 390 mm and 470 mm, respectively.

Table 1. *Geographical location of weather stations inside the Caucasian region.*

№ n/n	Weather stations	Longitude (°N), Latitude (°E)	Height above the sea level, m (m a.s.l.)	Annual sum precipitation, $\bar{x}$ (мм)
Plain stations (< 500 m a.s.l.)				
1	Izberg (Caspian zone)	42.34° N; 47.45° E	21	280
2	Kizlyar (Caspian zone)	43.51° N; 46.43° E	-17	313
3	Makhachkala (Caspian zone)	42.59° N; 47.31° E	173	346
4	Derbent (Caspian zone)	42.04° N; 48.17° E	30	392
5	Mozdok (steppe zone)	43.44° N; 44.39° E	126	473
6	Prokhladnaya (steppe zone)	43.46° N; 44.05° E	198	487
7	Rostov-on-Don (steppe zone)	47.14° N; 39.44° E	64	609
8	Izobil'nyi (steppe zone)	45.22° N; 32.42° E	194	620
9	Krasnodar (steppe zone)	45.20° N; 38.58° E	26	693
10	Maykop (steppe zone)	44.37° N; 40.05° E	270	810
11	Sochi (Black Sea zone)	43.35° N; 39.73° E	57	1636
Foothill stations (500–1000 m a.s.l.)				
12	Buinaksk	42.49° N; **47.07° E**	560	470
13	Stavropol	45.03° N; 41.58° E	540	567
14	Cherkessk	44.17° N; 42.04° E	526	587
15	Kislovodsk	43.54° N; 42.43° E	819	650
16	Nalchik	43.22° N; 43.24° E	500	640
17	Vladikavkaz	43.21° N; 44.40° E	680	930
Mountain stations (1000–2000 m a.s.l.)				
18	Teberda	43.45° N; 41.73° E	1280	802
19	Akhty	41.28° N**; 47.44° E**	1054	390
High-mountain station (> 2000 m a.s.l.)				
20	Terskol	43.15° N; 42.30° E	2144	936

Based on the results of the regression analysis of annual and seasonal precipitation, linear trend coefficients were obtained that characterize the averaged rate of local changes in atmospheric precipitation over the entire territory of southern Russia during 1961–2018. The *F*-test criterion determines the significance of trends in the change in precipitation regime (trends are statistically significant at *Sig.* <0.05). In all climatic zones, there was both an increase (70%) and a decrease (30%) in seasonal precipitation amounts, mostly these trends are statistically insignificant. Statistically significant changes at the 5% level took place only for positive trends in *the amount of precipitation* at some stations in all climatic zones:

- in the winter season in the Caspian (Makhachkala by 7.3 mm/month/10 yrs, *D* = 10%), foothill (Kislovodsk by 3.9 mm/month/10 yrs, *D*= 9%) and mountain (Akhty by 2.8 mm/month/10 yrs, *D* = 8%) zones;

- in the spring season in the mountainous (Teberda by 11.9 mm/month/10 yrs, *D* = 10%) and alpine (Terskol by 12.7 mm/month/10 yrs, *D* = 8%) zones;

- in the summer season, no significant increase in the amount of precipitation was determined at any station.

- in the autumn season in the steppe (Maykop by 12.3 mm/month/10 yrs, *D* = 7% and Prokhladnaya by 8.8 mm/month/10 yrs, *D*= 12%) and foothill (Kislovodsk by 6.3 mm/month/10 yrs, *D* = 9 % and Cherkessk by 7.5 mm/month/10 yrs, *D* = 10%) zones.

The decrease in *the amount of precipitation* is statistically insignificant in all climatic zones and was most observed in the summer season, while the significance of trends in the steppe (Mozdok by -9.9 mm/month/10 yrs, *D* = 6%, *Sig.*= 0.062) and foothill zones (Kislovodsk by - 13.3 mm/month/10 yrs, *D*= 6%, *Sig.*= 0.071) of negative trends in the rates of changes in precipitation amounts are close to the statistically significant level *Sig.* = 0.05.

For *daily maximum precipitation* in all climatic zones, both an increase (75%,) and a decrease (25%) in seasonal precipitation were observed, mainly these trends are statistically insignificant. Statistically significant changes at the 5% level took place only for positive trends of daily maximum precipitation at some stations in all climatic zones:

- in the winter season in the Caspian (Izberg by 1.5 mm/month/10 yrs, *D* = 8%, Derbent by 2.0 mm/month/10 yrs, *D* = 10%) and foothill (Kislovodsk by 0.7 mm/month/10 yrs, *D* = 8%, Cherkessk by 0.9 mm/month/10 yrs, *D* = 10%) zones;

- in the spring season in the Caspian (Makhachkala by 1.9 mm/month/10 yrs, *D* = 8%) zone;

- in the summer season in the foothill (Nalchik by 2.0 mm/month/10 yrs, *D* = 10%) zone;

- in the autumn season in the steppe (Prokhladnaya by 2.1 mm/month/10 yrs, *D* = 7%), Rostov-on-Don by by 2.9 mm/month/10yrs, *D* = 13%) zone.

A statistically insignificant decrease in daily maximum precipitation was observed in all climatic zones, its most noticeable decrease took place in the summer season.

In all climatic zones, an increase (85%) of the seasonal number of days with precipitation of at least 20 mm (*NR20*) is mainly observed, which is mostly statistically insignificant.

Statistically significant changes in *NR20* at the 5% level took place for positive trends:

- in the winter season in the Caspian (Derbent by 0.2 days/month/10yrs, *D* = 11%) and mountain (Akhty by 0.1 days/month/10yrs, *D* = 7%) zones;
- in the autumn season in the steppe (Abundant by 0.2 days / month / 10 yrs, D = 7%) zone.

Analysis of changes in the «basic triad» precipitation for the period 1961–2018 showed that the trends of changes in annual precipitation amounts in different zones of the southern Russia are different, while:

- annual sum precipitation increases slightly in all climatic zones and only in the steppe zone - statistically significant at 5% level;
- daily maximum precipitation (in the year as a whole) generally have a weak positive trend and only in the steppe zone do they increase statistically significantly;
- number of days with precipitation of at least 20 mm (for the year as a whole) have both positive and negative trends, all statistically insignificant.

Regression statistics (the slope of the linear trend a (mm/month/10yrs), the coefficient of determination (R^2), Fisher's criterion (*F*-test), the significance of *Sig*.) of the seasonal and annual series of precipitation sums, daily maximums and the number of days with precipitation at least 20 mm, averaged for the entire territory of southern Russia, are presented in Table 2 and Fig.1.

Table 2. *Statistical characteristics of the linear regression of the precipitation in the southern Russia for 1961-2018.*

Y=ax+b	**winter**		**spring**		**summer**		**autumn**		**annual**	
	a (R^2)	*F test / Sig.**	*a* (R^2)	*F test / Sig.**	*a* (R^2)	*F test / Sig.**	*a* (R^2)	*F test / Sig.**	*a* (R^2)	*F test / Sig.**
precipitation sums, *a, mm/ month/yrs*	0,14 (0,01)	0,65/ 0,42	0,27 (0,03)	1,53/ 0,22	-0,25** (0,01)	0,48/ 0,49	**0,56 (0,07)**	**4,10/ 0,048**	0,66 (0,02)	1,43/ 0.24
daily maximum precipitation, *a, mm/ month/yrs*	*a* (R^2)	*F test / Sig.**	*a* (R^2)	*F test / Sig.**	*a* (R^2)	*F test / Sig.**	*a* (R^2)	*F test / Sig.**	*a* (R^2)	*F test / Sig.**
	0,02 (0,01)	0,51/ 0,48	0,03 (0,01)	0,53/ 0,47	0,05 (0,02)	1,31/ 0,26	**0,10 (0,08)**	**4,65/ 0,04**	0,09 (0,05)	3,11/ 0.08

NR20, a, days/month/ yrs	*a* (R^2)	*F- mecm/ Sig.**	*a* (R^2)	*F- mecm/ Sig.**	*a* (R^2)	*F- mecm/ Sig.**	*a* (R^2)	*F- mecm/ Sig.**	*a* (R^2)	*F- mecm/ Sig.**
	0,00 (0,00)	0,01/ 0,92	0,01 (0,04)	2,57/ 0,11	0,00 (0,01)	0,46/ 0,50	**0,02 (0,27)**	**20,87/ 0,00**	0,01 (0,03)	1,81/ 0.18

** trends significant at the 95% level (Sig. <0.05) are highlighted in bold;*
*** negative trend values are highlighted in gray*

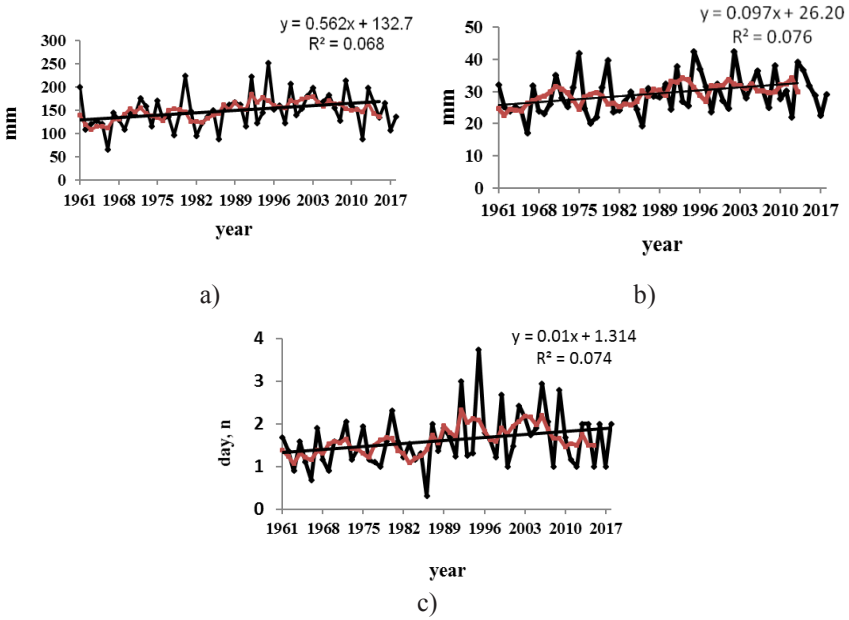


Figure 1. *Autumn precipitation with linear trends, 1961-2018, southern Russia. Red line - moving average of precipitation amounts (4-th years); the trend is statistically significant at the 5% level: a) suml precipitation (D = 6.8%, b) daily maximum precipitation (D = 7.6%),*
c) number of days with precipitation at least 20 mm (D = 7.4%).

It follows from Table 2 and Fig.1 that the statistical significance of the *F*- test (at the 5% level) for determining a *significant increase* in the sum precipitation and daily maximum precipitation, as well as the number of days with precipitation at least 20 mm, was *Sig.* = 0.048; 0.04; 0.00 for the *autumn season* (at the expense of two steppe stations - Prokhladnaya and Rostov-on-Don). Changes in the precipitation regime in other seasons and in the year as a whole are statistically insignificant.

Conclusion

The signal about climate change in precipitation is weak: throughout the southern Russia, with the exception of the negative trend of summer precipitation amounts, there was mainly a statistically insignificant increase in seasonal precipitation amounts, daily precipitation maxima and the number of days with precipitation of at least 20 mm (Table 2). *Positive trends statistically significant* at the 5% level took place for the averaged amounts of precipitation, daily maximum precipitation and the number of days with precipitation of at least 20 mm in the southern Russia in the *autumn* season.

Analysis of changes in precipitation amounts (base triad) for the period 1961–2018. showed that the trends of changes in annual precipitation in different zones of southern Russia are different, while:

- annual sum precipitation increases in all climatic zones and is *statistically significant* in the *steppe zone*;

- daily maximum precipitation (for the year as a whole) generally have a positive trend and are *statistically significant* in the *steppe zone*;

- the number of days with precipitation of at least 20 mm (per year) have both positive and negative trends, all *statistically insignificant*.

Thus, according to the results of our study, the most significant increase in both the amounts of precipitation and daily maximums took place in the steppe zone, which is characterized by an arid climate with the least amount of annual and seasonal amounts of precipitation. Perhaps this is due to a change in the direction of movement of cyclonic atmospheric masses bringing precipitation to the steppe zone, i.e. the predominant influence of advective phenomena (horizontal transport of air masses) over convective ones (vertical transport, prevailing in the regions).

References

1. Climate change 2013: The physical science basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (pp. 1029–1136). Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press. https://doi.org/10.1017/CBO9781107415324.024

2. Kobysheva, H.B. (2001). Climate of Russia. St. Petersburg: Gidrometeoizdat, 655 pp.

3. Pendergrass, A. G., & Knutti, R. (2018).The uneven nature of daily precipitation and its change. Geophysical Research Letters, 45. https://doi.org/10.1029/2018GL080298

4. Zolina, O., A. Kapala, C. Simmer, S. K. Gulev: Analysis of extreme precipitations over Europe from different reanalyses: a comparative assessment.// Global and Planetary Change, 2007, 44, pp.129-161.

5. Trenberth, K. E., et al. (2003), The changing character of precipitation, Bull. Am. Meteorol. Soc., 84, 1205–1217, doi:10.1175/BAMS-84-9-1205.

6. "Report on the peculiarities of the climate in the territory of the Russian Federation for 2018." M .: Roshydromet. 2019.- 79p.http://climatechange.igce.ru/index.

7. IPCC, 2014: Climate Change, 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [main group of authors, R.K. Pachauri and L.A. Meyer (ed.)]. IPCC, Geneva, Switzerland, 163 pp.

8. Ashabokov B.A., Tashilova A.A., Kesheva L.A., Taubekova Z.A. Trends in Precipitation Parameters in the Climate Zones of Southern Russia (1961–2011)// Russian Meteorology and Hydrology. 2017. Vol. 42. No3. P. 150-158.https://elibrary.ru/item.asp?id=28798786

9. Ashabokov B.A., Tashilova A.A., Kesheva L.A., Teunova N.V. Analysis of climate change in the Caucasus region: the end of the 20th - the beginning of the 21st century // CLIMATE. Special issue: Climate Variability and Change in the 21th Century (Basel, Switzerland), 2019,7,11. pp. 1-15. doi:10.3390/cli7010011

10. Byul A., Tsefel P. SPSS: the art of information processing. Analysis of statistical data and recovery of hidden patterns. SPb .: DiaSoftUP. 2002. 608p.

11. A.D. Nasledov SPSS 19: Professional Statistical Analysis of Data.- SPb .: Peter, 2011. 400 p.

DOI 10.34660/INF.2020.43.57.034

2020-2029年北高加索地区平坦区的季节性温度预测
FORECAST OF SEASONAL TEMPERATURES IN THE FLAT ZONE OF THE NORTH CAUCASUS REGION FOR 2020-2029

Teunova Nataliya Vyacheslavovna
Senior Scientist
High-Mountain Geophysical Institute
Kesheva Lara Asirovna
Candidate of Physics and Mathematics Sciences, Research Officer
High-Mountain Geophysical Institute

注解。 基于1961-2019年期间的气象参数数据。 对北高加索地区平原地区的平均季节温度序列进行了分析和预报。 时间序列的分析和预测是基于在Caterpillar -SSA程序中实施的奇异频谱分析方法。 在Caterpillar-SSA计划的帮助下，对2020-2029年的平均季节温度进行了预测，发现直到2029年，平均季节温度变化的总体趋势仍然是积极的。

关键词：平均季节温度，预报，奇异频谱分析，主成分，北高加索地区。

Annotation. *Based on the data of meteorological parameters for the period 1961-2019. the analysis and forecast of the series of average seasonal temperatures in the plain zone of the North Caucasus region was carried out. The analysis and forecast of time series is based on the method of singular-spectral analysis, implemented in the Caterpillar -SSA program. With the help of the Caterpillar-SSA program, the forecast of average seasonal temperatures for the period 2020-2029 was carried out and it was found that the general trend of change in average seasonal temperatures remains positive until 2029.*

Keywords: *mean seasonal temperatures, forecast, singular spectral analysis, principal components, North Caucasian region.*

In recent years, the climate on Earth has noticeably changed: some countries suffer from abnormal heat, others from too harsh and snowy winters, unusual for these places.

In addition to warming, there is also an imbalance in all natural systems, which leads to a change in rainfall patterns, temperature anomalies and an increase in the frequency of extreme events such as hurricanes, floods and droughts.

Of great scientific and practical interest is the study of the mechanisms of occurrence of these phenomena, as well as the forecast of their occurrence and the development of methods to reduce the risks associated with them. The solution of these problems still encounters serious difficulties, first of all, this applies to the problem of forecasting the time series of meteorological parameters characterizing the temperature regime of the air [1-3].

To study random series, the method of Singular Spectrum Analysis (SSA) is increasingly used [4-9].

The method of singular spectral analysis (SSA) used in this work is implemented through the Caterpillar -SSA program [10, 11], which allows:

- to select a finite number of components in the time series, which were considered in the considered regular intervals;
- find hidden periodicities;
- based on the selected components, smooth the initial data;
- extract components with a known period;
- predict future values in the observed relationship.

The algorithm of the method is as follows: the original series is transformed into a scan matrix, then a singular decomposition of this matrix is carried out, that is, into a series of successive approximations, thereby revealing its internal structure. After that, from the obtained set of principal components, those are selected for which the series needs to be reconstructed.

The quality of predictive estimates in the SSA method depends on which eigenvectors are chosen to reconstruct the series, as well as on the width of the window L. row. The forecast of changes characterizing the temperature regime of air in different seasons of the year in the flat zone of the North Caucasus region for the period 2020-2029 is based on taking into account slow trends and cyclicalities hidden in time series.

To investigate the structure of a series of mean winter temperatures, the transformation, decomposition, grouping and restoration of the series were carried out, for which a variant of the SSA Caterpillar method was used without centering the observation matrix corresponding to the series. The periodogram was considered and the most significant periods of the series were identified, corresponding to the maximum powers (Figure 1).

A periodogram is a graph of the power of a process (or square of the amplitude) versus frequency.

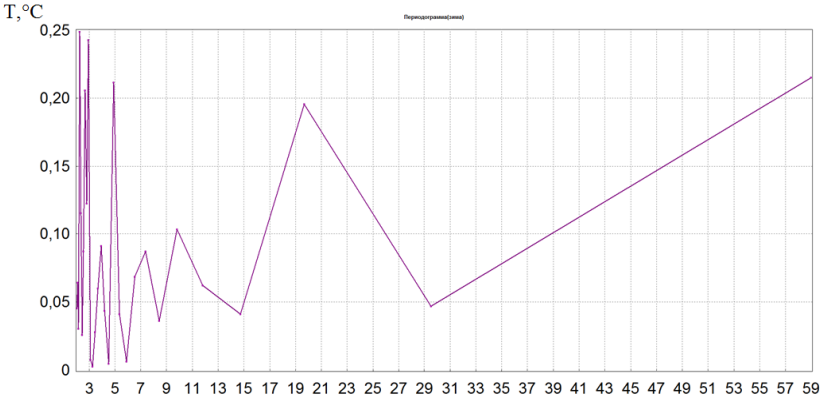


Figure 1 – *Periodogram of the average winter temperature for 1961-2019 in the flat zone of the North Caucasus region.*

The periods corresponding to the maximum power peaks are 19,5 years, 5 years, and 3 years.

After reconstruction and approximation of the series, a number of average winter temperatures were predicted (blue broken line, figure 2). To check the quality of the forecast, we took a 20-year preemptive series, meaning that the forecast started in 1999. We built a forecast series from 1999 to 2019, and continued the forecast for the next ten points to 2029. A vertical black line separates the beginning of the forecast from the actual data.

The forecast results are shown in figure 2 and table 1.in the 1999-2019 lead time interval, it is possible to compare the actual data with the forecast values.

The relative forecast error (%) was calculated using the formula:

$$\delta = \frac{1}{n}\sum_{i=1}^{n}\left|\frac{y_{pr} - y_{ac}}{y_{pr}}\right| \cdot 100\% \qquad (1)$$

where y_{pr} – predicted values in the lead interval 1999-2019;

y_{ac} – actual values in the same interval 1999-2019.

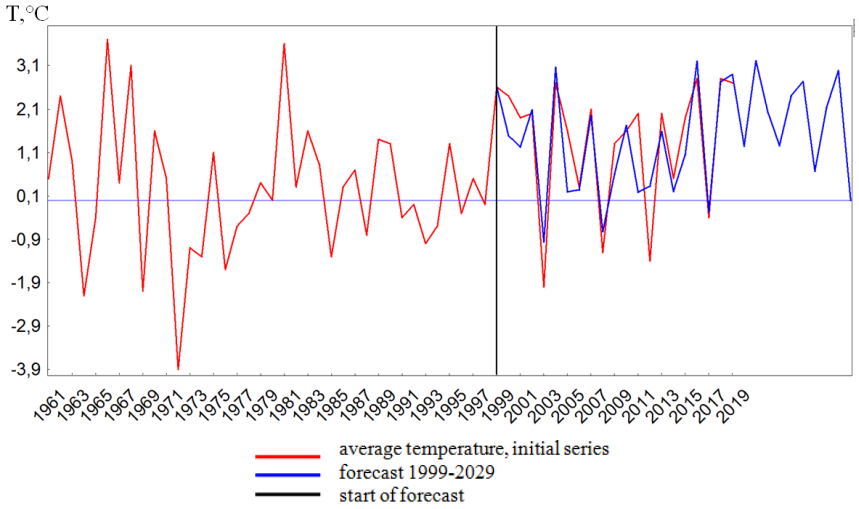


***Figure 2** – Recurrent method of forecasting a series of average winter temperatures for 1999-2029, in the flat zone of the North Caucasus region, 10 GC*

***Table 1** - Forecast of the average winter temperature in the plain zone of the North Caucasus region*

№ p/p	Years	Original row	Forecast row	№ p/p	Years	Original row	Forecast row
1	1961			54	2014	0,5	0,2
	…			55	2015	1,9	1,1
39	1999	2,6	2,6	56	2016	2,8	3,2
40	2000	2,4	1,5	57	2017	-0,4	-0,3
41	2001	1,9	1,2	58	2018	2,8	2,7
42	2002	2,0	2,1	59	2019	2,7	2,9
43	2003	-2,0	-1,0	***average***		**1,34**	**1,20**
44	2004	2,7	3,1	60	**2020**	-	1,3
45	2005	1,6	0,2	61	**2021**	-	**3,2**
46	2006	0,3	0,2	62	**2022**	-	2,0
47	2007	2,1	1,9	63	**2023**	-	1,3
48	2008	-1,2	-0,7	64	**2024**	-	2,4
49	2009	1,3	0,6	65	**2025**	-	2,7
50	2010	1,6	1,7	66	**2026**	-	0,7
51	2011	2,0	0,2	67	**2027**	-	2,1
52	2012	-1,4	0,3	68	**2028**	-	**3,0**
53	2013	2,0	1,6	69	**2029**	-	0,0

The forecast error is δ = 11,7% <20%. In 2021 and 2028, the maximum values of the average winter temperature should be expected.

In the case of choosing one main component, we get the most general predictive trend line showing an increase in average winter temperature until 2029 (Figure 3).

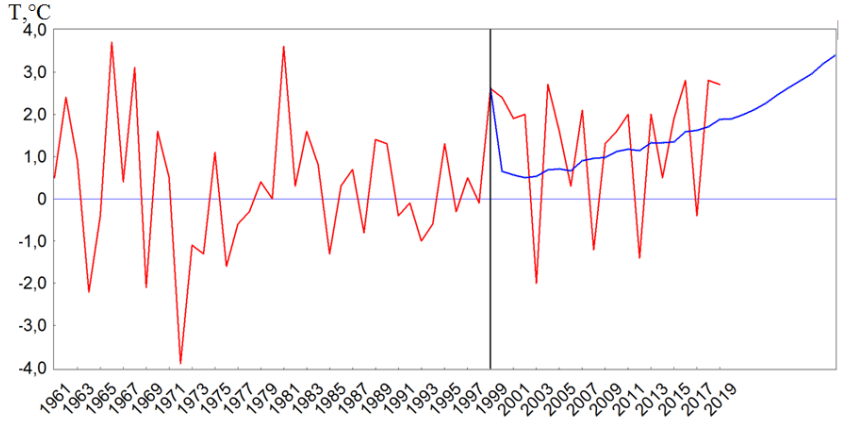
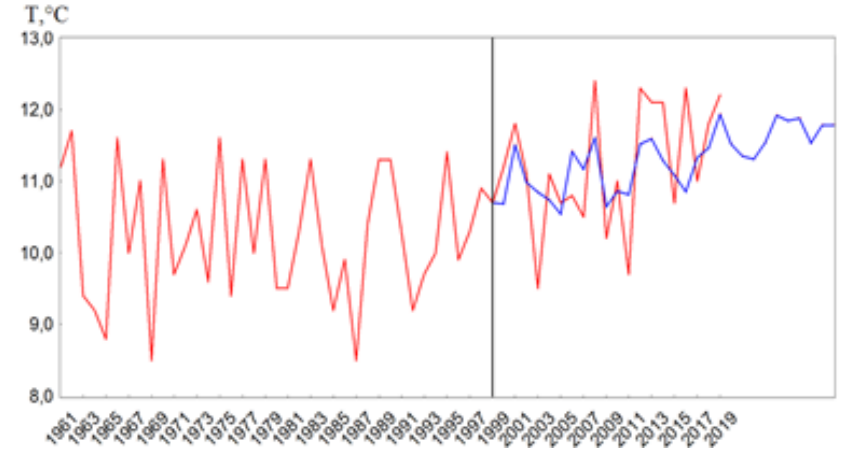


***Figure 3** – Reconstructed series of average winter temperatures for one main component in the plain zone of the North Caucasus region 1999-2029.*

The analysis and forecast of the average temperature of the spring, summer and autumn seasons were carried out in a similar way.

The general trends in the change in the average spring temperature, obtained with the release of 1GC, demonstrate a linear increase in the average spring temperature. Figure 4 shows the forecast when using 5GC.



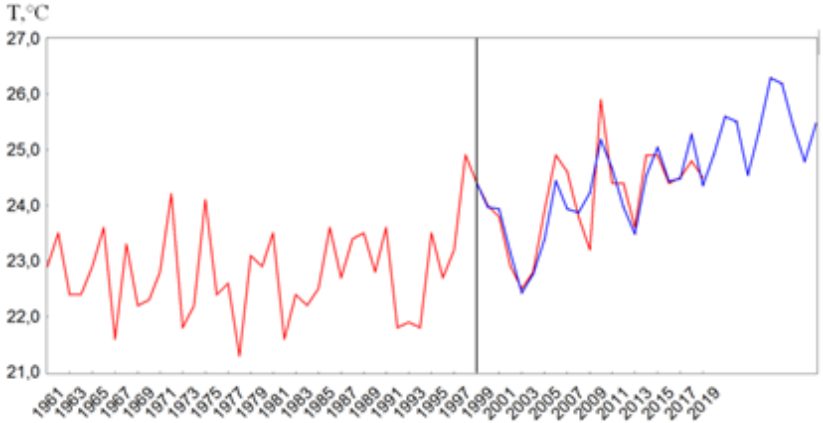
Year	°C
2020	11,5
2021	11,3
2022	11,3
2023	11,5
2024	11,9
2025	11,8
2026	11,9
2027	11,5
2028	11,8
2029	11,8

***Figure 4** – Forecast of a series of average spring temperatures for five main components*

As a result of the selection of parameters that allow for the maximum division of the series into additive components, a forecast was obtained for average spring temperatures, with a forecast error of 3,9%.

The forecast of the temperature regime in the summer season with slow trend changes (if 1GK is selected) also shows an increase in temperature.

For the forecast, two parameters were chosen that determine the division of the series into additive components: the window width L = 30 and the number of the main components of the 8GC. The forecast was carried out in a recurrent way, the forecast results for 2020-2029 are presented in Figure 5.



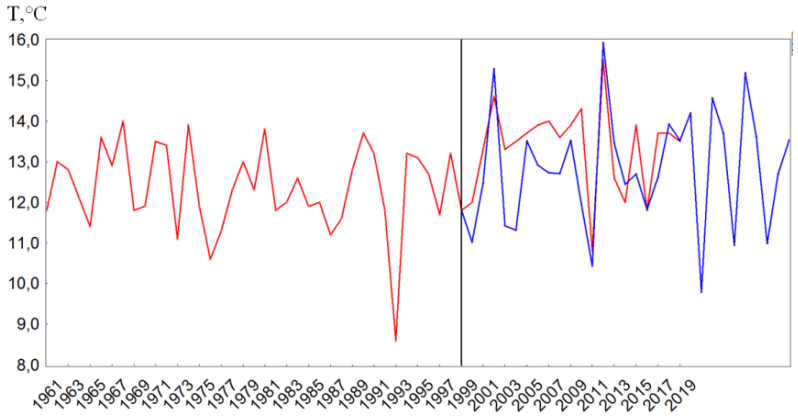
Year	°C
2020	24,9
2021	25,6
2022	25,5
2023	24,5
2024	25,4
2025	26,3
2026	26,2
2027	25,4
2028	24,8
2029	25,5

Figure 5 *– Forecast of the average summer temperature series for the eight main components*

The forecast is recurrent, and is fairly accurate with a forecast error of δ=4,0%< 20%.

The forecast of autumn temperatures when selecting 1GC shows a slight increase in the average autumn temperature in the period up to 2029.

The results of forecasting for 2020-2029 when selecting 10GC are shown in figure 6.



Year	°C
2020	14,2
2021	9,8
2022	14,6
2023	13,7
2024	10,9
2025	15,2
2026	13,6
2027	11,0
2028	12,7
2029	13,5

Figure 6 – *Forecast of a series of average autumn temperatures for ten main components*

As a result of forecasting by the "SSA Caterpillar" method, it was found that the general trend of changes in the average seasonal temperatures of the North Caucasus region remains positive until 2029. The forecast error in the spring, summer and autumn seasons is from 3,8% to 6,1%. which is <20%, and this indicates a high forecast accuracy. In the winter season, the forecast error is 11,7%.

According to the results of the forecast in the period 2020-2029. the maximum values of average summer temperatures of 26,3°C and 26,2°C will fall on 2025 and 2026. The forecast of average autumn temperatures showed that the lowest temperature is expected in 2021 (9,8°C), approximately the same temperature was in the North Caucasus Federal District in 1993 (8,6°C), it was the lowest for the period 1961-2019.

References

1. D.Coumou, J. Lehmann, J. Beckmann The weakening summer circulation in the Northern Hemisphere mid-latitudes// Science. 2015.

2. V. V. Popova Summer warming in the European territory of Russia and extreme heat in 2010 as a manifestation of large-scale circulation trends in the late XX century-XXI century. / / Meteorology and hydrology. 2014. No. 3. - Pp. 37-49.

3. Barnston A. G., Livezey R. E. Classification, seasonality and persistence of low-frequency atmospheric circulation patterns / / Monthly Weather Rev., 1987, No. 115. - p. 1083-1126.

4. Kiktev D. B., Kruglova E. N., Kulikova I. A. large-Scale modes of atmospheric variability: Part II. Influence on the spatial distribution of temperature and precipitation on the territory of Northern Eurasia. Meteorology and hydrology, 2015, no. 4. - P. 5-15.

5. Walker, Gilbert T. (1933). "Seasonal Weather and its Prediction". Nature. 132 (3343): 805–808.*

6. Bardin M. Yu., Platova T. V. long-Period variations of temperature extremes on the territory of Russia and their relation to changes in large-scale atmospheric circulation and global warming // Meteorology and hydrology, Planeta publishing house (Moscow), 2019, No. 12. - Pp. 5-19.

7. Nesterov E. S. North Atlantic oscillation: atmosphere and ocean. - M.: Triada, Ltd, 2013. - 144 p.

8. Nesterov E. S. low-Frequency variability of atmospheric circulation and the level of the Caspian sea in the second half of the twentieth century // Meteorology and hydrology. No. 11, 2001, Pp. 27-36.

9. Nesterov E. S. Features of atmospheric circulation in the North Atlantic in recent decades / In: Modern problems of ocean and atmospheric dynamics. Collection of articles dedicated to 100th anniversary of birthday of Professor P. S. Lilacina. – M.: Triada, 2010. – P. 269–280.

10.Sherstyukov A. B. Long-term trends and changes of soil temperature the last decades in the permafrost zone of Russia // Proceedings of fgbu VNIIGMI-WDC. 2014. T. 178. P. 224-232.

11. Ashabokov B. A., Tashilova A. A., kesheva L. A., Teunova N. V. Forecasting average summer temperatures in the South of the European territory of Russia in 2019-2023, Nauka. Innovations. Technologies", No. 2, 2020, Stavropol. Pages 115-134.

NOTES

科学出版物

上合组织国家的科学研究：协同和一体化

国际科学大会的材料

2020年10月28日。中国北京

编辑A.A.Siliverstova
校正A.I.尼古拉耶夫

2020年11月03日。中国北京。
USL。沸点：98.7。 订单253.流通500份。

在编辑和出版中心印制
无限出版社