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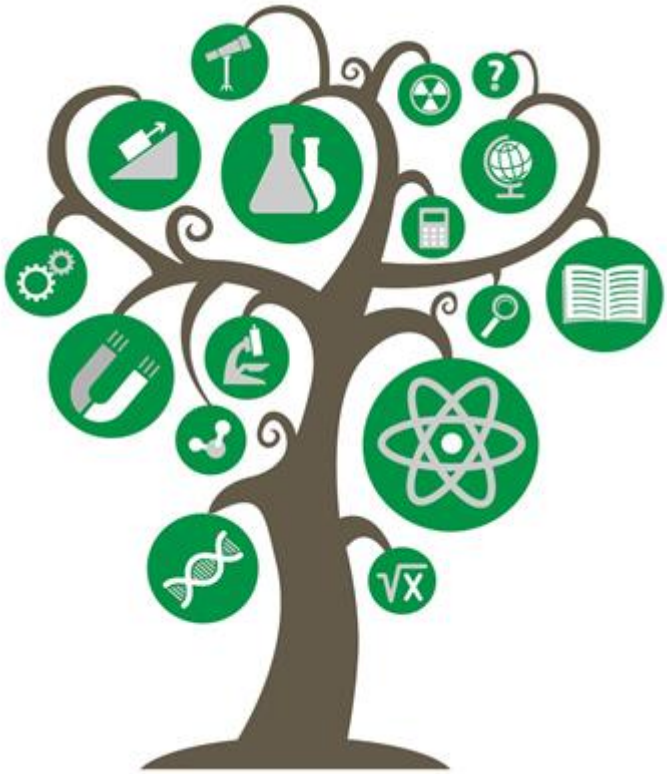

MULTIDISCIPLINARY YOUTH ACADEMIC RESEARCH CONFERENCE

«Science Present and Future: Research Landscape in the 21st century»

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Science Present and Future: Research Landscape in the 21st century: материалы научно-практической конференции с международным участием, Иркутск, 20 мая 2025 г. [Электронный ресурс] / Отв. ред. Н.А. Свердлова. – Электрон. дан. – Иркутск, Образовательный центр ИНЦ ИрИХ СО РАН, 2025. – 79 с. – https://moodle.isc.irk.ru/course/view.php?id=85.

Сборник включает в себя тезисы докладов научно-практической конференции с международным участием «Science Present and Future: Research Landscape in the 21st century» (г. Иркутск, 20 мая 2025 г.). Работы молодых исследователей охватывают направления естественных, гуманитарных, технических наук, развивающиеся в научных институтах России.
Конференция проведена в соответствии с Планом междисциплинарных мероприятий Сибирского отделения РАН на 2025 год.

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Секция 1. Multidisciplinary Science and Technology

Секция 2. Innovative Research and Advances in Science

Multidisciplinary Science and Technology

UDC 551.583

INFLUENCE AND FORECASTING OF NATURAL FACTORS IN ENERGY SYSTEMS

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Keywords: *natural factors, energy systems, climate change, forecasting, ensemble methods.*

Energy and water systems are fundamental for ensuring economic sustainability and public safety. However, their functioning is strongly connected to the natural environment, on which they depend for resources and stability. The increasing influence of natural factors (PF), made worse by global climate change, makes a complex study of these effects necessary, along with the development of reliable long-term forecasting methods. This work aims to categorize such factors, analyze their impact on infrastructure, study regional features, and evaluate current forecasting approaches.

The main groups of natural factors that influence how energy and water management systems [1] work include: hydrological (river runoff, water inflow to reservoirs, ice regime, etc.); weather and climatic (atmospheric parameters like

temperature, precipitation, pressure, etc., characteristics of heating and growing periods); heliophysical (solar activity); geophysical (geomagnetic and electrical state of the planet, atmospheric structure); planetary (changes in Earth's rotation speed, tidal forces); heliogeophysical (sun-Earth connections, solar energy potential); ecological (influence of energy facilities on ecosystems, environmental sustainability); geographic and regional (terrain features, climatic zones).

Different types of energy generation are affected differently. Hydropower is especially sensitive to seasonal and yearly changes in river flow. Solar and wind power plants depend on cloudiness, wind activity, and atmospheric cycles. Thermal power plants are vulnerable to water shortages during dry periods with extremely high temperatures [4]. Extreme floods and low water periods on rivers significantly impact the normal functioning of water management systems, creating emergency situations.

Global climate change has a systemic and increasing influence on the characteristics and functioning of energy and water management systems. These changes are particularly dangerous for regions that depend heavily on river flow, where water levels are decreasing, ice conditions are changing, and ecological conditions are worsening.

The Lake Baikal and Angara River basin is a unique nature-energy system that is especially vulnerable to climate change [3]. In recent decades, this region has seen: long periods of low water, linked to less precipitation and higher temperatures; changes in ice conditions, increasing evaporation and disrupting seasonal regulation; sharp flow fluctuations, which make it difficult for the Angara cascade hydropower plants to operate and create risks of unused water releases or water shortages.

Particular challenges are presented by uneven precipitation, ice jams, rising temperatures, and unstable year-to-year flow, which increases pressure on hydropower, shipping, and water supply. These processes require adapting infrastructure, increasing monitoring, and including regional specific details in forecasting. Giving a reliable forecast is difficult without considering the regional

context. Localizing global climate models needs integration with reanalysis data and data from meteorological stations.

Forecasting natural factors is key to effective strategic management of energy and water management systems. Monitoring and reanalysis systems (like NCEP/NCAR, GPCC) provide a reliable information base for climate and hydrometeorological forecasts. Within the GeoGIPSAR information and analytical system, developed at ISEM SB RAS, ensemble methods for processing data from global climate models (CFSv2) have been implemented. A component for monitoring and accumulation [2] forecast ensembles has been developed, along with a component for verification using reanalysis data, and a clustering module aimed at refining probabilistic forecast scenarios.

Natural factors have a systemic and multi-level influence on how energy and water management systems function. Increasing climate changes require rethinking infrastructure management strategies and integrating reliable forecasting tools. Reliable forecasting is possible only by combining classical methods and models with modern technologies, and also by considering regional specific features. Key directions for future development include:

using weight coefficients for individual forecast ensembles, based on analysis with verified data, to increase forecast accuracy; integrating ensemble methods with neural network technologies; adding new components to the existing system interface project in the form of a special web service for the GeoGIPSAR system.

Thus, forecasting natural factors allows for early assessment of likely climate changes, which plays a key role in effective energy system management. These assessments are necessary not only for ensuring infrastructure stability but also for minimizing environmental risks, increasing the reliability of transport networks, and considering social and economic impacts.

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UDC 004.514

DEVELOPMENT OF A HARDWARE AND SOFTWARE COMPLEX FOR INSPECTION OF STEEL TURBINE WATER CONDUITS OF HYDROE-LECTRIC POWER PLANTS: DESIGN OF THE SOFTWARE INTERFACE

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Keywords: *nondestructive testing, robotics, interface design, software, electric power, hydroe-lectric power station.*

Penstocks of hydroelectric power plants play a key role in the operation of the associated hydro unit**.** It is the penstock that delivers water from the reservoir to the blades of the hydroturbine. Maintaining penstocks in working condition is critical, as their failure can lead not only to the shutdown of a single hydro unit but potentially of the entire plant in the event of a large-scale accident.

The aim of this work is to develop a hardware and software complex for the inspection of penstocks in order to promptly detect and eliminate existing issues, as well as prevent potential future problems.

In our case, the system consists of a robotic cart that moves along the inner surface of the penstock and performs inspections using cameras and sensors, along with a control panel running dedicated software. This article focuses on the development of the software interface for this system.

The interface includes key elements necessary for real-time monitoring and control of the robotic platform during penstock inspection. It features:

- Live video feeds from multiple cameras with camera selection;
- Display of current coordinates and a 3D visualization of the platform's position;
- Real-time wall thickness readings;
- A data table with saved measurements and operator comments;
- Battery level and signal quality indicators;
- Speed control and status display;
- Screen recording options, including for defect documentation;
- Adjustable settings for lighting and movement modes.

Figure 1 shows the result of the designed software interface.

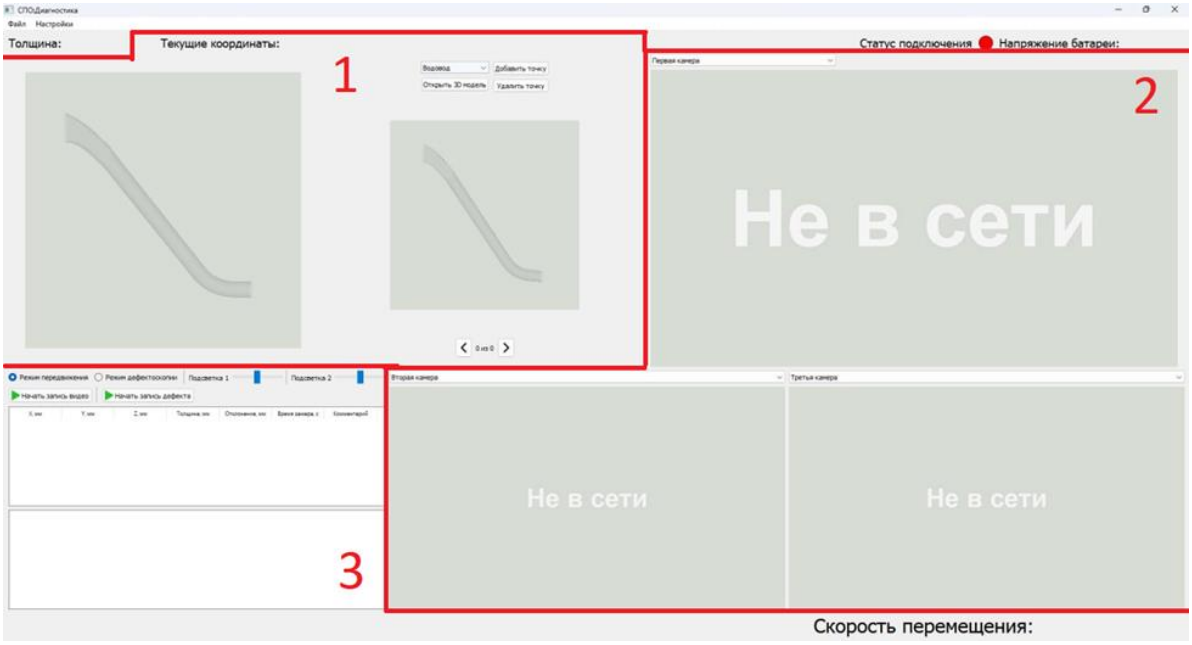

Figure 1. The resulting software interface

Let us take a closer look at the interface shown in Figure 1:

1. This section displays the 3D model and the current position of the robotic platform in space. The coordinates of the platform are recorded and shown as a point on two 3D models. The smaller model represents a cross-section of the larger one. Buttons below the smaller model allow the user to switch between different cross-sections. The buttons above the small model are used to open the penstock model and to add or remove measurement points. The measured wall thickness is also displayed above this section.

2. This section provides live video streams from three cameras mounted on the robotic platform. Each video feed has a dropdown menu above it to select a specific camera. Above this block, information is displayed regarding the signal quality between the control panel and the robotic platform, as well as the current battery voltage, which helps the operator assess the battery charge status. Below the video streams, the current movement speed of the robotic platform is displayed.

3. This part includes a table for storing measurement results (coordinates, time of measurement, wall thickness, deviation from the norm, operator's comments). Below the table is an information window that displays various system messages. Above the table, there are buttons for screen recording and defect recording (essentially a focused screen recording of a specific inspected section). Higher up, there are buttons for switching movement modes and sliders for adjusting the brightness of the platform's lighting.

As a result of this work, a concept was developed and a user interface was implemented for software used in the inspection of steel turbine penstocks at

hydroelectric power plants. Future plans include expanding the interface's functionality and integrating additional options for personalizing the user experience. The proposed design approach can be adapted for interface development in similar systems across various application domains.

UDC 620.9: 332.144

A REGRESSION MODELS APPLICATION FOR A HEAT CONSUMPTION FORECASTING AND MONITORING

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Keywords: *heat energy, regression models, heat energy consumption, energy consumption.*

The energy supply systems in Russia are operated in harsh climatic conditions. Heat supply systems play a key role in ensuring safe and comfortable living conditions for people, as well as uninterrupted and high-quality energy supply to industrial plants. In this regard, high-quality monitoring and planning of the heat supply systems development is a strategic area of scientific research.

The issues of forecasting energy consumption by the residential sector and economic sectors are discussed in [1-5]. The main methods of solving the tasks set are the use of specific energy consumption indicators, bringing these indicators in the future to standard values or a level comparable to European countries. However, the average heat consumption in residential buildings often does not reflect the real picture, as it fails to into account the climatic features of the region, the actual state of building envelopes, quantitative and qualitative characteristics of energy saving measures. In industry, the forecast is based on indicators of energy intensity of various industries that are adopted based on the foreign experience. In this case, it is quite difficult to draw analogies due to significant differences in

economic development and technological potential of the countries. The authors of [6-12] use regression models to predict energy consumption, while the forecast period is short-term.

This article continues the research of the authors of [13-14] on the study of regression dependencies of heat consumption. With regression analysis methods a study of the dynamics of heat consumption changes in the retrospective period has been conducted. Regression coefficients were determined for several types of linear and nonlinear regression models describing heat consumption. The study was conducted at the highest hierarchical level. The total heat consumption in the country was taken as the object of the study [15]. A comparison of linear and nonlinear regression models of heat energy consumption is carried out. Changes in thermal energy consumption in retrospect are most accurately described by the autoregressive model (fig.1a). The length of the forecast period covered by the regression model depends directly on the retrospective period for which the model is derived. It is assumed that the forecast period should not exceed 1/3 of the retrospective period [16-19]. According to this circumstance, the heat consumption forecast is made until 2030 (fig.1b).

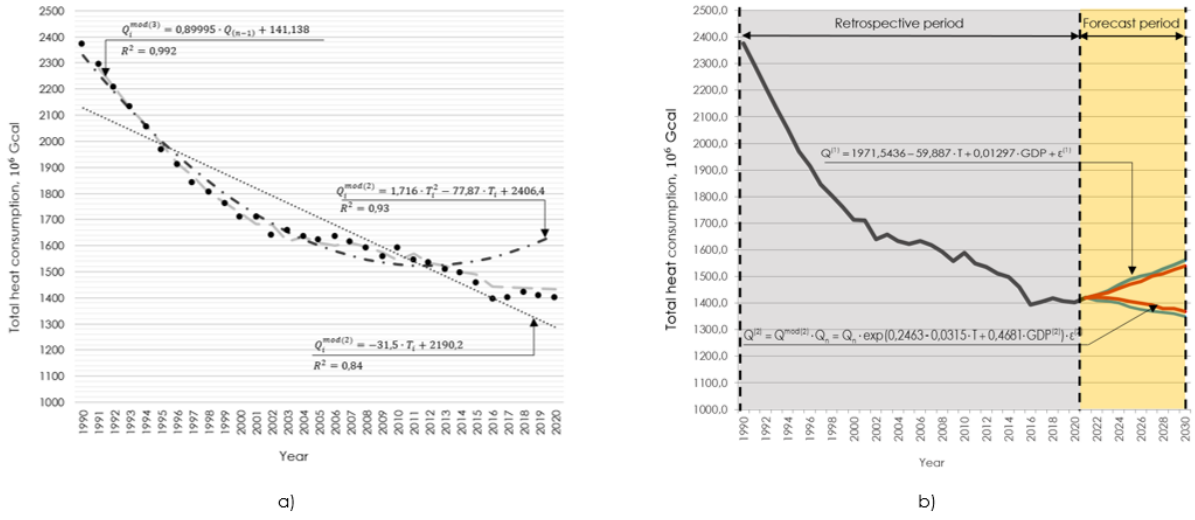

Figure 1. An application of a multiple liner model and non-liner regression model for heat consumption forecasting and monitoring: a) for a heat consumption monitoring; b) for a heat consumption forecasting.

The regression models considered quite well describe the change in heat consumption in the retrospective period. The autoregressive model is the most

suitable for monitoring heat consumption levels, as well as for filling time series. However, it is impossible to use an autoregressive model to predict heat consumption due to the fact that this model only takes into account existing trends. A multiparametric regression model that takes into account economic and social factors is better suited for predicting thermal energy consumption.

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UDC 547.379

SYNTHESIS OF NEW FUNCTIONAL ORGANOTELLURIUM COMPOUNDS BASED ON TELLURIUM TETRABROMIDE

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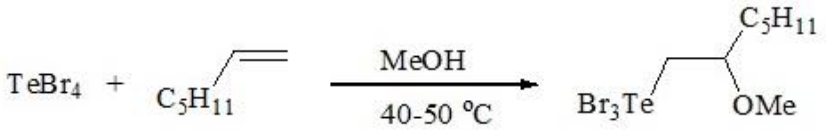
***Keywords**: tellurium tetrabromide, alkyl halides, 1-heptene, alkyl propiolates, organotellurium compounds.*

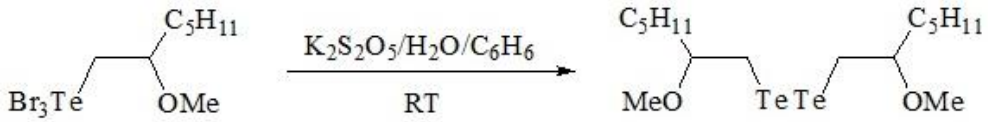
Efficient regioselective syntheses of new functional organotellurium compounds: tribromo(2-methoxyheptyl)-λ^4-tellane, bis(2-methoxyheptyl)ditellane, alkyl (2-methoxyheptyl)tellurides and alkyl (Z)-3-(2-methoxyheptyltellanyl)-2-propenoates in high yields were developed based on tellurium tetrabromide, 1-heptene, alkyl halides and alkyl propiolates.

The methoxytelluration reaction was carried out by heating tellurium tetrabromide with 1-heptene in a methanol solution giving tribromo(2-methoxyheptyl)-λ^4-tellane in 98% yield (Scheme 1).



Scheme 1. The methoxytelluration reaction of $TeBr_4$ with 1-heptene.

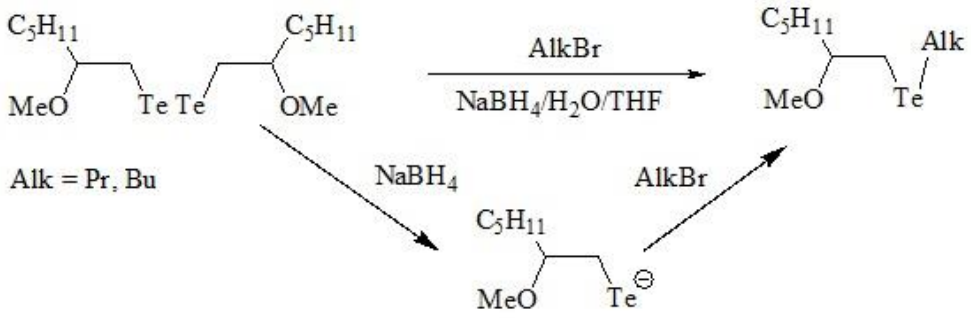
The reduction of tribromo(2-methoxyheptyl)-λ^4-tellane was realized in the two-phase system, containing an aqueous solution of potassium pyrosulfite ($K_2S_2O_5$), which played a role of reducing agent (Scheme 2).



Scheme 2. The synthesis of bis(2-methoxyheptyl)ditellane.

The use of this reduction system made it possible to obtain the target product, bis(2-methoxyheptyl)ditellane, in 90% yield (Scheme 2).

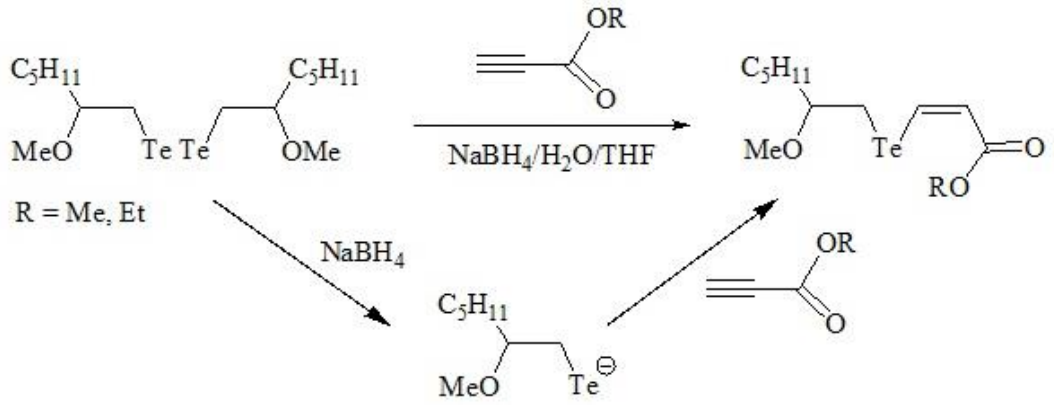
The obtained product, bis(2-methoxyheptyl)ditellane, was used as a starting compound for the synthesis of new derivatives by the reduction-alkylation reaction with propyl and butyl bromides. The reduction of bis(2-methoxyheptyl)ditellane by sodium borohydride led to the generation of (2-methoxyheptyl)tellurolate anion, which was involved in the nucleophilic substitution reaction with propyl and butyl bromides, affording alkyl (2-methoxyheptyl)tellurides in 91-94% yields (Scheme 3).



Scheme 3. The synthesis of alkyl (2-methoxyheptyl)tellurides.

Alkyl (2-methoxyheptyl)tellurides were also obtained by the reduction-alkylation reaction of tribromo(2-methoxyheptyl)-λ^4-tellane with propyl and butyl bromides using a larger amount of the reducing agent, $NaBH_4$. However, the yields of alkyl (2-methoxyheptyl)tellurides in this case were lower (78-82%).

The regio- and stereoselective synthesis of alkyl (Z)-3-(2-methoxyheptyltellanyl)-2-propenoates was developed from bis(2-methoxyheptyl)ditellane and alkyl propiolates (Scheme 4). The triple bond of alkyl propiolates is activated towards nucleophilic addition reaction by the electron-accepting carboalkoxy group.



Scheme 4. The regio- and stereoselective synthesis of alkyl (Z)-3-(2-methoxyheptyltellanyl)-2-propenoates.

The (2-methoxyheptyl)tellurolate anion, generated by the reduction of bis(2-methoxyheptyl)ditellane, undergoes addition to the triple bond of alkyl propiolates in a regio- and stereoselective fashion, giving alkyl (Z)-3-(2-methoxyheptyltellanyl)-2-propenoates in 90-93% yields (Scheme 4).

UDC 574.34

DEEP LEARNING MODELS FOR ANALYZING GENETIC VARIATION IN POPULATIONS

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Keywords*: deep learning, autoencoders, population structure, genetic variation, viral DNA, phylogenetics, alignment-free methods, machine learning.*

The increasing accessibility of genomic data has highlighted the need for innovative computational tools to analyze genetic variation and uncover population structure. In this study, we propose a novel deep learning framework utilizing autoencoders to analyze and cluster genetic sequence data. By leveraging the capacity of autoencoders for dimensionality reduction and pattern recognition, our approach enables the discovery of population structure and genetic diversity without requiring sequence alignment.

Unlike traditional methods that rely on sequence alignment for phylogenetic and population analyses, our model processes raw genetic sequences directly. This makes our approach particularly advantageous for analyzing datasets with highly variable sequences, such as viral DNA, where alignment is often challenging. The autoencoder model learns a compressed representation of the input sequences during training, which serves as the basis for clustering genetic data and uncovering latent genetic structures.

Furthermore, we demonstrate how the learned representations can be used to construct alignment-free phylogenetic trees. This capability significantly accelerates the analysis of evolutionary relationships and enables insights into genetic data at scales that were previously computationally prohibitive.

Our results establish that deep learning models based on autoencoders are effective tools for genetic variation analysis, offering a versatile, scalable, and precise alternative to traditional alignment-dependent methods. This approach

holds promise for applications in virology, population genetics, and evolutionary biology, potentially transforming how we analyze genetic datasets and interpret their underlying structure.

UDC 550.4.02

ANALYSIS OF GEOCHEMICAL DATA ON POTENTIAL ORE-BEARING AREAS IN THE SOUTH OF THE SIBERIAN PLATE

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***Keywords**: minerals, ecogeochemistry, sedimentary rocks, geochemical studies, statistical analysis.*

Placer gold manifestations in the south of the Siberian platform are known in the basins of the Angara, Lena, Katanga and Lower Tunguska rivers. Gold mineralization of various genetic types has been established in the sediments of the cover of the south of the Siberian platform [1]. The placer gold manifestations selected for the ecological and geochemical study belong to mineralization presumably of the Carlin (Nevadian) type, which is represented by stratified deposits of disseminated ores with finely dispersed gold. The objects of study will be the Buraevskaya and Ust-Kutskaya gold-bearing areas (Figure 1, 2) identified as promising prospective for the Carlin type of mineralization. The research focuses on three prospective areas for Carlin-type mineralization: Buraevskaya and Ust'-Kutskii goldfields. The study of sedimentary rock samples will be performed by wave-dispersive X-ray fluorescence analysis (WDXFA) using the classical method and the method involving fusion with lithium metaborate on an S8 TIGER spectrometer (Bruker AXS, Germany) with built-in SPECTRAplus software. The study of the selected samples for Hg content will be performed by atomic

absorption spectrometry on an RA-915M analyzer with a PIRO-915+ pyrolytic attachment (Lumex, Russia).

Figure 1. Buraevskaya gold-bearing area

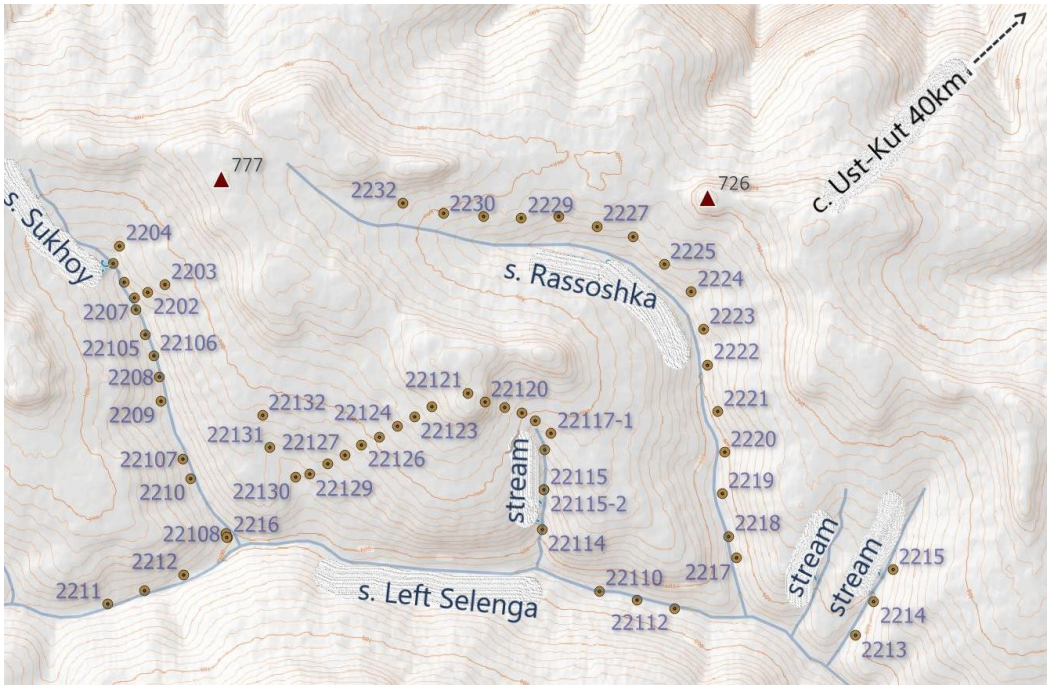

Figure 2. Ust-Kutskaya gold-bearing area

Characteristic features of gold mineralization of the Carlin type from a geochemical point of view are: geochemical halos of Au, As, Hg, Sb, Tl, (Te), Ba with a low content of Ag and polymetals (Pb, Zn); the main associated minerals are arsenopyrite (FeAsS) and marcasite (FeS_2) [2]. In the Buraevskaya gold-bearing area, gold placer halos are accompanied by geochemical halos of Hg, As and other

natural components, which are elements of hazard classes I–III. The Ust-Kutskaya gold-bearing area is characterized by stratiform manifestations of Pb and Cu, which belong to hazard classes I and II. There are many settlements and arable lands within and around these gold-bearing areas. Abnormal concentrations of these toxic elements can harm human health and pose a danger to the environment.

In this regard, it is important to conduct not only geological and mineralogical studies at these sites, but also ecological and geochemical ones in order to identify the level of environmental pollution by hazardous natural components and the sources of their entry (natural or man-made).

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MODELING THE ENERGY SYSTEMS DEVELOPMENT IN THE CONTEXT OF THE ENERGY TRANSITION USING SPINEOPT

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Keywords*: renewable energy sources, energy transition, modeling, carbon capture and storage technologies.*

Introduction. In recent years, there has paid more attention to environmental and climate issues. Increased consumption of hydrocarbons, intensive growth of the energy, industrial, and transport sectors increases greenhouse gas emissions, which may lead to global warming. Therefore, there is a need for the energy transition that aims to create low-carbon energy systems that either use no fossil fuels at all as renewable energy sources (RES), or use them applying carbon capture and storage technologies at the same time.

A salient feature of the current stage of development planning of energy systems is an incessant increase in the dimensionality of the problems being solved and the level of granularity of the mathematical treatment of technologies. The use of modeling allows taking into account the factors, such as uneven energy production and consumption, technological characteristics of energy sources as well as economic and environmental aspects of the problem.

There are a large number of software products for modeling energy systems, which were reviewed in [1-3]. This article discusses modeling energy systems in the context of the energy transition using the SpineOpt software tool.

Modeling of energy systems in SpineOpt. The use of SpineOpt was considered by the example of solving the problem of the energy system developing of Novikovo located on the Tonin-Aniva peninsula in the Sakhalin region.

This area has a high wind and solar power potential, which makes it possible to include of RES generation in the analysis. Moreover, the Novikovskoye coal deposit is located on this territory. This open-pit mine produced germanium-bearing metallurgical coal and mudrocks, as well as thermal coal. In recent years, there has been an increase in germanium demand and prices, what makes coal gasification with germanium recovery from the fly ash relevant. At the same time, coal gasification opens the way for obtaining various products from syngas: hydrogen, methanol, and others. The use of coal entails consideration carbon capture and storage technologies.

Due to the diversity of options available for the development of the Tonin-Aniva peninsula energy system, SpineOpt proves to be a suitable tool for its modeling.

Figure 1 shows the model for studying the areas of possible energy system development of this territory in SpineOpt. The model of the system spans a time horizon extending from 2025 to 2050.

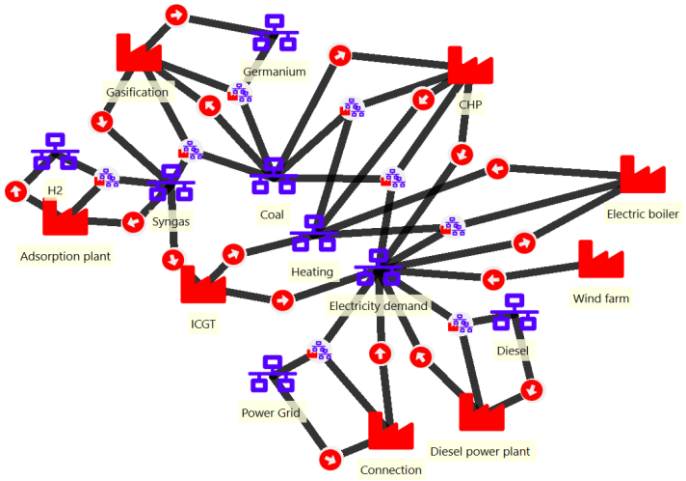

Figure 1. A SpineOpt model of Tonino-Aniva peninsula energy system development

The modeling was carried out for two scenarios of the energy system development: conservative and innovative, in which the same values of constraints on CO_2 emissions were set, but the different values of constraints on new capacity additions of RES. As a result of modeling over the estimated period of 25 years, the following optimal development scenarios were obtained. For the conservative scenario, capital investments and CO_2 emissions amounted to 50.84 million dollars and 2457.53 thousand tons, respectively. For the innovative scenario, capital investments and CO_2 emissions amounted to 55.96 million dollars and 2032.06 thousand tons, respectively.

Thus, the conservative scenario is economically feasible, but not environmentally friendly, because consumers are mostly supplied with energy from traditional energy sources. The innovative scenario, on the contrary, is environmentally friendly, because the share of RES there is higher, than in the previous scenario, but not financially beneficial.

Conclusion. A model of the Tonin-Aniva peninsula energy system developed in SpineOpt can be applied to study different options of its long-term development in the context of the energy transition. Using SpineOpt model the analysis of the energy system development was carried out under two scenarios: conservative and innovative, with constraints on CO_2 emissions and new capacity additions of RES. The resulting solutions make it possible to identify promising directions for the technological development of the energy system.

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PHYLOGENETIC DIVERSITY OF ANAEROBIC MICROORGANISMS FROM SEDIMENTS OF LAKE BAIKAL INVOLVED IN THE OXIDATION OF POLYCYCLIC AROMATIC HYDROCARBONS

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***Keywords**: PAHs biodegradation, Lake Baikal.*

Lake Baikal has been an object for scientific research for a long time. Its origin, location and characteristics create conditions for the development of a huge number of microorganisms in a variety of conditions. Natural oil occurrences are also a unique feature of the Baikal. In addition to Lake Baikal, this phenomenon has been found in two freshwater lakes: the deep-water rift Lake Tanganyika and shallow Lake Chapala [1].

Oil samples collected both from the surface of the lake in the area of B. Zelenovskaya and in the upper layer of bottom sediments of the "Zelensip" oil-methane sipe are biodegraded aromatic naphthenic oil [1]. Over a long period of time, the initial alkane paraffin oil was transformed into aromatic naphthenic oil due to the prolonged presence of oil accumulations in the near-surface bottom sediments of the lake [1].

Degradation of n-alkanes and PAHs occurs not only due to physico-chemical processes, but also under the influence of microbial communities of sedimentary strata in deep anaerobic sediments. Previous experimental studies have shown that anaerobic oxidation of polycyclic aromatic hydrocarbons mainly occurs in deep sediments, as evidenced by their high degree of biodegradation (up to 65%), regardless of the electron acceptors present in the medium [2, 3].

However, it remains unknown which microorganisms are involved in the degradation of PAHs in the sediments of the Baikal and what metabolic capabilities they have. All this underlines the importance of their comprehensive study for understanding the mechanisms of oil biodegradation processes in the Baikal and possible biotechnological applications.

The purpose of this work was to study the phylogenetic diversity and obtain pure cultures of anaerobic microorganisms that oxidize polycyclic aromatic hydrocarbons (PAHs) from sediments of the Zelenovskaya river area.

The preparation of anaerobic media and the cultivation of microorganisms were carried out using the Hangate method. The total DNA was isolated by

phenol-chloroform extraction, the 16S rRNA gene fragment was amplified using a polymerase chain reaction, and the 16S rRNA fragments were sequenced using the Sanger method. The sequences obtained as a result of sequencing were compared with sequences from the NCBI international databank using the BLASTN program (http://www.ncbi.nlm.nih.gov/blast). The structures were analyzed using ClustalW V 1.4 (http://www.ebi.ac.uk/clustalw). Sequence comparison and phylogenetic tree construction were performed using the MEGA 12 software package (http://www.megafile.co) using "Neighbor-Joining" grouping algorithms, the "Kimura-2-parameters" model. The statistical reliability of the branching was evaluated using a "bootstrap analysis" using the corresponding function of the same program.

For the research, storage cultures were cultivated at a temperature of 4 ° C in anaerobic mineral media enriched with bicarbonate, sulfate, nitrate ions and PAHs: phenanthrene (Ph) and fluoranthene (Flu) (Table 1). In storage cultures with electron acceptor NO_3, there was no growth of microorganisms, therefore, further cultivation it was not carried out. Two samples were taken using epifluorescence microscopy to determine the phylogenetic diversity (Fig. 1).

	Electron acceptors		
	HCO^-	SO_4^{2-}	NO_3^-
Name of cumulative crops	**Flu_H_2**	Flu_O_4	Flu_O_3
	Ph_H_2	**Ph_O_4**	Ph_O_3

Table 1. Symbols of accumulative crops

The morphology of cells in a storage culture with fluoranthene and bicarbonate ion is represented by long and short rods, as well as rods assembled in consortia of 2-3 cells. No spores were detected. The morphology of the cells of the storage culture with phenanthrene and sulfate ion was more diverse and included straight or slightly curved rods, consortia of two rods and long rods (Fig. 1).

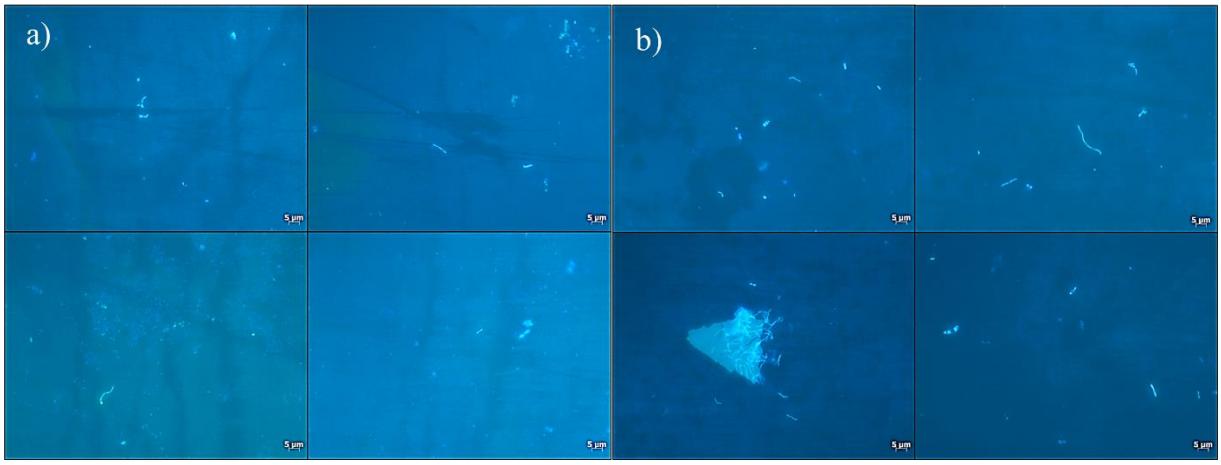

Fig. 1. Epifluorescence microscopy of storage cultures: (a) – Flu_H_2, (b) – Ph_SO_4

Analysis of the 16S rRNA clonal gene library showed that sequences from a storage culture with fluoranthene and bicarbonate ion (Fig. 2a) formed two clusters. Sequence F_36 was 96-97% homologous to sequences belonging to the genus *Sedimentibacter*, which are characterized as obligate anaerobes found in oil-contaminated ecotopes. The other five sequences (F_38) had 96% similarity to bacteria of the *Clostridiaceae* family.

Sequences from the storage culture with phenanthrene and sulfate ion also formed two clusters. Sequences of the *Pseudomonadota* phylum prevailed in the Ph_SO_4 accumulation culture library (Fig. 2b) (98-99% similarity). In particular, the genus *Polaromonas* (P_7) and the genus *Pseudomonas* (P_9). These microorganisms are characterized by the ability to decompose hydrocarbons in psychrophilic and mesophilic conditions. The second cluster consisted of sequences that belonged to bacteria of the *Clostridia* class and were 95-98% homologous to our sequences. The Clostridia class is represented by the genera *Lachnotalea* and *Konateibacter* (P_5, P_13), which are characterized as anaerobic microorganisms with the potential to participate in the anaerobic degradation of hydrocarbons in combination with other microorganisms.

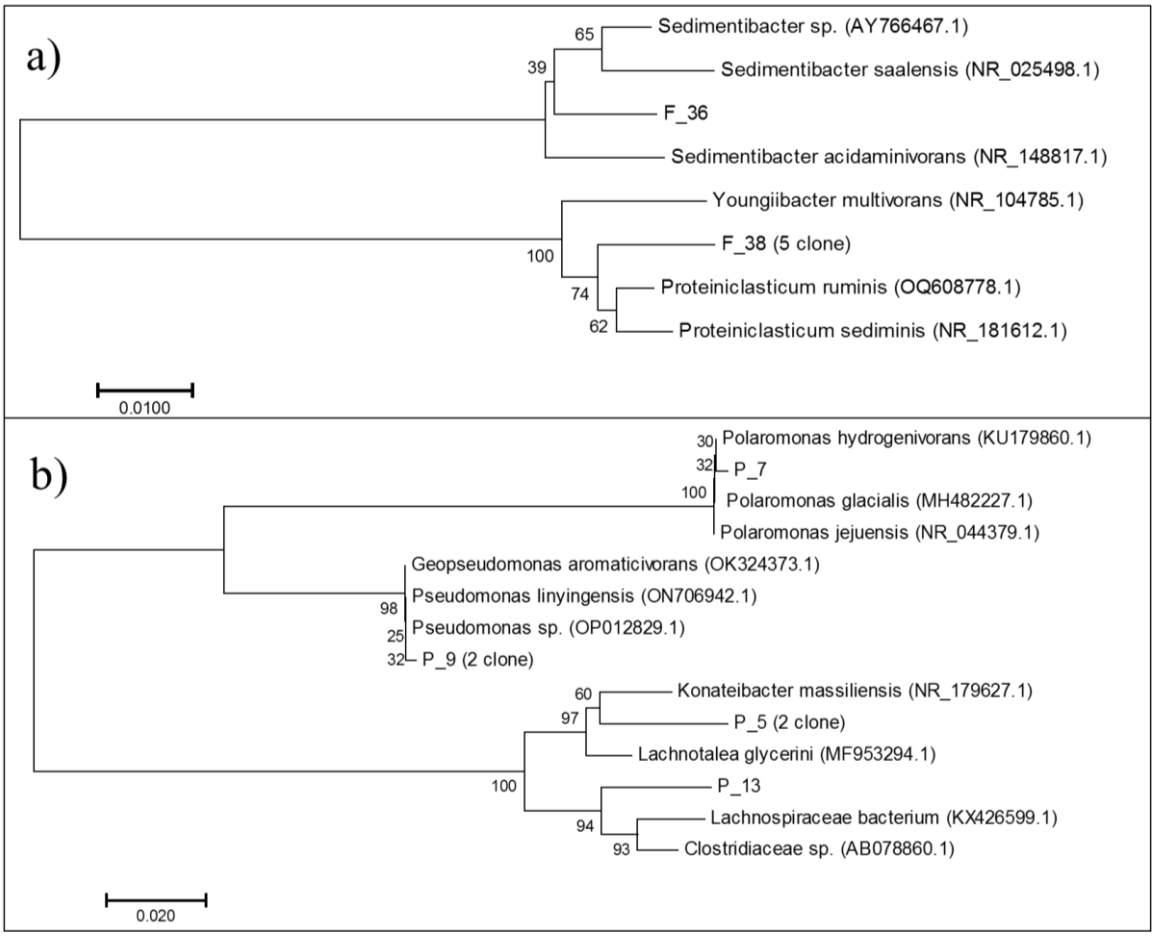

Fig. 2. Phylogenetic tree based on sequences of the 16S rRNA gene obtained from storage cultures: (a) – Flu_H_2, (b) – Ph_SO_4

The sequences founded in the storage cultures were homologous to the sequences of bacteria, which are characterized by the ability to biodegrade oil components. It means suspected participants in the biodegradation of PAHs may be bacteria of the family *Clostridiaceae*, as well as bacteria of the genus *Polaromonas* and *Pseudomonas*, for which these properties are shown in the literature.

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APPLICATION OF THE SUBMERSIBLE SPECTROFLUORIMETER PHYCOPROBE FOR EXPRESS MONITORING OF PHYTOPLANKTON ON THE EXAMPLE OF SOUTHERN BAIKAL

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Keywords: *fluorimetry, PhycoProbe, Rinko AAQ-117, phytoplankton, fluorescence, chlorophyll, Southern Baikal.*

The study of phytoplankton is of fundamental importance for understanding ecological processes in any water area, since phytoplankton is at the base of the food web of a water body, and, accordingly, reflects its productivity [2]. At the same time, phytoplankton reacts sensitively to changes in living conditions, forming both vertical and horizontal heterogeneities of spatial distribution. In this regard, identifying correlations and patterns between environmental factors and the structure of plankton communities is an urgent ecological task.

The classic method of phytoplankton counting is sampling horizons, followed by counting the number of cells and their biomass [1]. An alternative to this method is to estimate the phytoplankton biomass based on the main pigment of green plants - chlorophyll a. Chlorophyll is contained in almost all cyanobacteria and unicellular algae, so its concentration can, with certain assumptions, be

considered a criterion for the quantitative assessment of the total phytoplankton biomass. To calculate chlorophyll, it is necessary to extract the pigments, after which an analysis is carried out using a spectrophotometer [3].

The significant disadvantages of the above-described methods are their labor intensity and time-consuming , which does not allow them to be used for rapid biomass assessments. Currently, submersible spectrofluorimeters have been developed and manufactured that have the ability to measure chlorophyll fluorescence in real time from a vessel. We tested one of these devices on Lake Baikal as part of the expedition on the R/V G.Yu. Vereshchagin in September 2024. For this purpose, detailed measurements were taken in a 100-meter depth layer on the Marituy -Solzan section in the southern basin of the lake. The section, with a total length of 30 km, was divided into 11 stations.

Spectrofluorimeter was used to study the spatial distribution of phytoplankton. PhycoProbe (bbe Moldaenke GmbH, Germany) with the function of dividing microalgae into groups according to their fluorescence spectra. The maximum immersion depth of the device is 100 m. Factory calibrations were used in the work. The total concentration of chlorophyll a and its equivalent concentrations for the main representatives of each phytoplankton group calculated using PhycoProbe software.

Rinko AAQ177 water quality probe (JFE Advantech, Japan) was used, which measures the following physical and chemical parameters of water: temperature, electrical conductivity, dissolved oxygen (mg/l), hydrogen index, oxidation-reduction potential (mV), photosynthetically active radiation (PAR, μmol m-2 s-1), turbidity (FTU), and chlorophyll fluorescence.

PhycoProbe device were compared with the Rinko AAQ-117 device. The Rinko AAQ-117 probe is widely used in research work on environmental monitoring at the LIN SB RAS [4], so in this work its data can be considered a standard for comparison.

As a result, PhycoProbe was used to obtain spatial distribution data phytoplankton at the Marituy -Solzan section for the second half of September

2024 (Fig. 1), and also compared them with the main hydrophysical characteristics measured by the Rinko AAQ177 probe.

The obtained data revealed both horizontal and vertical heterogeneity of chlorophyll distribution in section E.

The work was carried out within the framework of the state assignment of the LIN SB RAS No. 0279-2021-0004.

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PROSPECTS FOR EXTRACTION OF VALUABLE ELEMENTS FROM HYDROMINERAL RAW MATERIALS OF OIL AND GAS CONDENSATE FIELDS OF THE BAIKIT ANTECLISE

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***Keywords**: Baikit Anticlinorium, Siberian Platform, microcomponents, industrial brines, lithium.*

The Baikit Anticlinorium, located within the Siberian Platform, is a significant geological structure. Its subsurface hosts immense reserves of brines containing industrial concentrations of valuable microcomponents such as lithium (Li), strontium (Sr), rubidium (Rb), bromine (Br), boron (B), and cesium (Cs). Despite the fact that the extraction of valuable microcomponents from industrial brines has been actively investigated by numerous renowned hydrogeologists, the technology for extracting elements from brines has yet to be realized in practice as of 2023. [3].

Among the primary challenges that have hindered the industrial exploitation of this type of raw material, researchers in this field have identified the following issues: the significant depth at which industrial brines are found, which is associated with high extraction costs; the inaccessibility of the brine deposits; and the high production costs associated with the recovery of valuable elements.

In 2022, due to the rise in global lithium prices associated with the widespread adoption of lithium-ion and lithium-polymer batteries utilized in consumer electronics and automobiles, interest in the extraction and development of industrial brines in Eastern Siberia has revived. Despite a slight decline in lithium prices, a report by the United States Geological Survey (USGS) projects that by 2030, global consumption will increase sevenfold from the current level of 136,000 tons per year.

Against the backdrop of increasing interest from Russian mining companies in lithium, there has also been a growing interest in industrial brines, which can have lithium concentrations of up to 400 mg/L. To enhance the efficiency and profitability of lithium production, it is advisable to utilize industrial brines comprehensively and extract microcomponents such as lithium (Li), strontium (Sr), rubidium (Rb), bromine (Br), boron (B), and cesium (Cs), which are present in industrial concentrations. [2].

Fig. 1. Dynamics of global lithium consumption and fluctuations in lithium raw material prices.

Among the most promising sources of hydromineral materials, it is important to highlight the oil and gas fields located within the Baikit Anticline. The uniqueness of this group of fields lies in the fact that, due to their location in a zone of elevated reservoir pressure, they are primarily developed without the application of the water flooding system (or with its limited use). Consequently, the associated waters extracted during hydrocarbon production consist of pure industrial brines from the Riphean aquifer complex, in which there is no dilution of the concentrations of valuable elements.

The brines of the Riphean aquifer complex exhibit a mineralization ranging from 212 to 432 g/dm³, with an average value of 322 g/dm³, classifying them as concentrated and highly concentrated brines. The generalized formula of the chemical composition of industrial brines can be represented as:

$$Li42, Rb3{,}4\ Sr746, Br1814, \mathrm{M}212 - 432\ \frac{Cl100}{Ca25{-}61\ Na26{-}60\ Mg7{-}12}\ pH4{,}6 - 6{,}2 \quad (1)$$

The group of mineral deposits located within the Baikit Anticline represents a unique opportunity for the exploration of hydromineral resources. This is primarily because a complete cycle of extraction, separation from oil, and disposal of

industrial brines has already been implemented within this area. Consequently, the production of lithium from hydromineral raw materials can be initiated in the near future with minimal infrastructure investment. Within the aforementioned geological structure, there is potential for the extraction of over 20 million cubic meters of associated water per year.

Should the program for the extraction of valuable components from the brines be realized, preliminary aggregated estimates suggest a yield of 844 tons/year of lithium (Li), 14,900 tons/year of strontium (Sr), 69 tons/year of rubidium (Rb), and 36,280 tons/year of bromine (Br). The comprehensive utilization of hydromineral resources will facilitate the establishment of an autonomous resource base necessary for the sustainable development of high-tech sectors of the economy. This is a key factor in ensuring Russia's economic independence and the competitiveness of its economy in the 21st century.

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PREDICTION OF THE STATOR WINDING TEMPERATURE OF THE SAYANO-SHUSHENSKAYA HPP

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***Keywords**: hydro unit, stator winding temperature, diagnostics, machine learning, condition-based maintenance.*

The relevance of this work is related to the need to shift from scheduled preventive maintenance to condition-based maintenance, where one of the key requirements is the ability to predict the technical condition of equipment [1, p. 9]. Since existing equipment monitoring systems are designed only to assess the current technical condition, a new automated monitoring and diagnostic system is required, which can be implemented using machine learning techniques. To address the task of forecasting the stator winding temperature of a hydro generator, a linear regression model was used. The model was implemented in Python within the Jupyter Notebook environment.

From the upper level of the automated process control system (APCS) for hydro unit No. 7, the following parameters were collected over a one-year period: active power, water temperature at the inlet of the heat exchangers, average stator winding temperature, and the discrete signal "Steady-state mode." After data filtering, a linear regression model was built: $y = (a \cdot x + b) \pm \Delta t$, where y is the winding temperature, x is the active power, a and b are coefficients, and $\Delta t = 1.5 \cdot \sigma$. A graph of the model is shown in Figure 1.

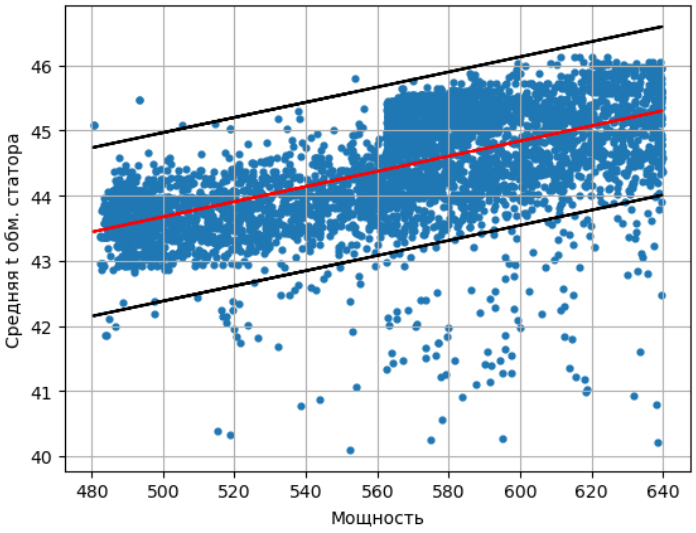

Figure 1. Linear regression plot with confidence interval

The issue was the insufficient accuracy of the model due to the absence of seasonal dependence, as shown in Figure 2. To address this problem, the dependencies of coefficients a and b on the inlet water temperature to the heat exchangers were established.

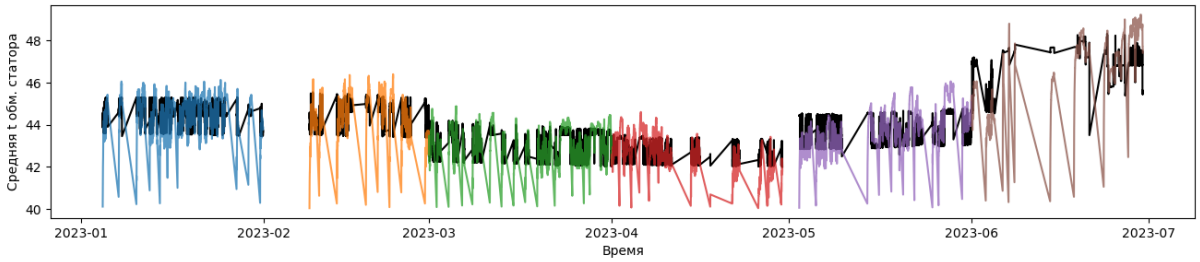

Figure 2. Comparison of actual and predicted temperature values

The final model predicts the temperature based on the dependence of coefficients a and b on the water temperature, which allowed for improved forecasting accuracy. A graph of the final model is shown in Figure 3.

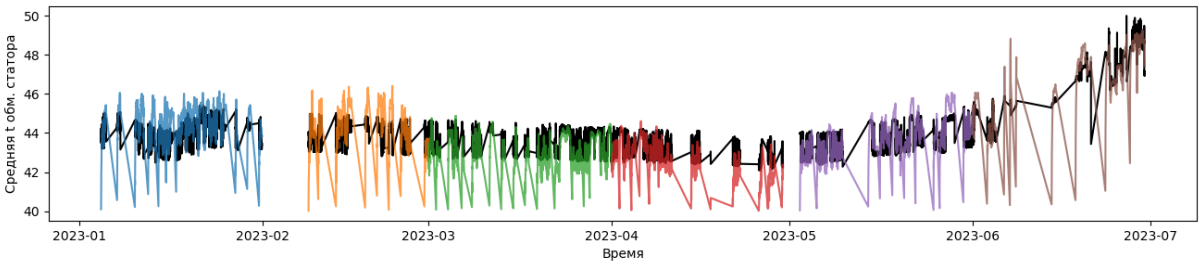

Figure 3. Comparison of actual and predicted temperature values of the final model

Ultimately, the principle of this model is that if the stator winding temperature exceeds the model value by more than Δt, a warning signal is issued to the station personnel indicating a deviation in equipment operation.

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Innovative Research and Advances in Science

UDC 004.89

MODERN APPROACHES TO ASSESSING THE QUALITY OF AI-GENERATED SCIENTIFIC TEXTS

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***Keywords**: artificial intelligence, generative language modelling, scientific texts, metrics.*

Generative AI models are renovating the landscape of scientific communication. They mechanize tasks such as drafting, summarization and translation, offering efficiency gains in academic writing, however, these tools raise critical questions about the trustworthiness, accuracy and quality of AI-generated content. This study presents a framework for assessing the outputs of generative language models using metrics and expert analysis.

The evaluation of AI-generated texts has evolved significantly over the past dec-ades. Initially, metrics like BLEU and ROUGE were introduced in the early 2000s to address the needs of machine translation and summarization tasks. BLEU (bilingual evaluation understudy) measures the lexical overlap of n-grams between generated and reference texts, with higher scores indicating greater similarity [7, p. 311]. It was presented as a method for estimating machine translation and has since become a norm for text quality assessment. ROUGE (recall-oriented understudy for gisting evaluation) studies content overlap through n-grams (ROUGE-1, ROUGE-2) [6, p. 74]. It is widely used in summarization tasks to measure recall and content preservation. A new metric such as Perplexity emerged, offering insights into the fluency of generated text by quantifying its predictability. Perplexity assesses the fluency of generated texts with lower values suggesting more predictable language use [1, p. 1137]. The advent of transformer-based architectures like BERT gave rise to semantic evaluation tools, such as BERTScore, using contextual embeddings to compare semantic similarity between the reference and generated texts, BERTScore focuses on contextual similarity rather than surface-level matches, and leverages the power of transformer-based models to evaluate meaning rather than exact word matching [8]. Another critical innovation is FactCC (factual consistency classifier) which ensures factual accuracy by aligning generated statements with verifiable sources [5]. Similarly, FEQA (faithfulness evaluation via question answering) generates and answers questions based on the generated text to assess its faithfulness to the reference. This approach was proposed by Durmus [2] as a means of verifying the reliability of abstractive summaries. One more metric to be analyzed is GPTScore which

relies on a GPT-based model to rate the quality of the generated text in terms of coherence and relevance [3]. The author highlighted its adaptability for evaluating various aspects of text quality.

In the experiment, each of the above metrics was applied to three texts generated by GPT-4, Claude and Gemini generative language models using a single prompt: write an analytical text on the topic of science communication and artificial intelligence based on the provided article, comparing them with the full text of the article: “Science communication in the age of artificial intelligence” by Kessler [4], in which a comprehensive exploration of how generative AI tools are reshaping science communication is provided. The expert assessment was performed by three independent re-viewers (specialists in scientific communication and linguistics). Each expert blindly received texts without specifying the model and assessed them according to previously developed criteria (coherence, informativeness, accuracy of facts, compliance with scientific style). The results are shown in the table (Figure 1).

Metric	GPT-4	Claude	Gemini
BLEU	**0.4**	0.36	0.38
ROUGE-1	**0.52**	0.47	0.5
ROUGE-2	**0.28**	0.23	0.26
Perplexity	26.1	**21.4**	31.7
FactCC	**0.87**	0.8	0.83
FEQA	**0.83**	0.77	0.81
BERTScore	**0.91**	0.88	0.89
GPTScore	**0.86**	0.8	0.84

Figure 1. Comparative analysis of AI-generated texts based on evaluation metrics

Among the evaluated systems, GPT-4 displayed the most balanced capabilities, achieving better result in both lexical overlap (BLEU: 0.40; ROUGE-1: 0.52) and semantic coherence (BERTScore: 0.91). Its outputs demonstrated contextual alignment with academic standards, combining syntactic precision with nuanced argumentation. Claude, while producing the most fluent text (perplexity: 21.4), prioritized readability over factual depth. On the contrary, Gemini prioritized technical accuracy, generating outputs rich in domain-specific detail.

Though, this emphasis came at the expense of fluency, as evidenced by elevated perplexity scores (31.7) and syntactic irregularities that compromised readability. Human expert evaluations, conducted across four criteria (coherence, informativeness, factual accuracy and stylistic adherence) corroborated these quantitative findings. However, this dual-method (metrics and human assessment) reveals no singular model achieves comprehensive superiority.

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LINGUISTIC TURN IN INTERNATIONAL RELATIONS THEORY: FROM STRUCTURALIST OPPOSITIONS TO POST-STRUCTURALIST DECONSTRUCTION OF POLITICAL IDENTITY

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Keywords: *linguistic turn, international relations theory, structuralism, post-structuralism, political identity, discourse analysis.*

The formation of political identity in international relations is a complex and dynamic process increasingly analyzed through the lens of the linguistic turn [4]. This intellectual shift, re-evaluating language as an active constructor of social and political reality, offers new perspectives on the deep mechanisms of interaction between states, nations, and other global actors. This study explores the potential of structuralism and post-structuralism – two influential theoretical directions within the linguistic turn – to analyze how language constructs boundaries, shapes collective identities, and mediates power relations in international affairs.

Traditional approaches in IRT, long focused on material factors like power distribution and state rationality, are increasingly complemented by linguistic factors. Language actively creates reality, shaping perceptions of friends and enemies, legitimacy, and possibility, directly impacting political decisions and international processes. Engaging with the linguistic turn is thus essential for developing more adequate explanatory models in IRT.

Structuralism, pioneered by Ferdinand de Saussure [5], views language as an ordered system where meaning arises from the relationships between signs. Binary oppositions – such as “us/them” – are key structuralist tools for understanding the cognitive frameworks that shape political identities and define symbolic boundaries in the international arena.

However, post-structuralism critically re-examines these stable structures. Thinkers like Jacques Derrida [2] highlight the inherent instability of meaning and the necessity of deconstruction to reveal internal contradictions and power hierarchies within binary oppositions. Michel Foucault [3] analyzes discourse as a historically conditioned system shaping knowledge and power, determining legitimate identities and excluding alternatives.

This study aims to demonstrate the analytical potential of structuralist and post-structuralist approaches for understanding political identity formation in IRT. It will justify the selection of Derrida's deconstruction and Foucault's discourse analysis as complementary tools for investigating political narratives and power relations within the linguistic turn. These methods allow for the examination of both deep cognitive structures and the dynamics of their construction and deconstruction in discursive practices, crucial for understanding identity formation and power relations internationally.

The discourse surrounding the 2024 Paris Olympic Games will serve as empirical material [1]. This global event provides a unique linguistic platform where national identities, political interests, and power relations, mediated by language and symbols, intersect. The analysis will focus on: the construction of the "us/them" opposition concerning the participation of specific national teams; the deconstruction of narratives of “unity” and “openness” against the backdrop of social and political contradictions in France; and the analysis of the opening and closing ceremonies as political performances constructing French national identity and its global role.

The analysis of discourse around Russian and Belarusian athletes will identify binary oppositions used to legitimize participation decisions, while deconstruction

will expose underlying contradictions and political motives. The study of “unity” narratives will reveal the gap between idealized discourse and social reality, showing how certain voices are marginalized. Finally, the analysis of the ceremonies will uncover the symbols and oppositions used to construct French national identity and the power relations embedded within these representations.

Ultimately, this research contributes to linguistically oriented IRT by demonstrating the analytical power of structuralist and post-structuralist approaches for understanding the complex dynamics of political identity formation and power relations in the international arena. By focusing on language and discourse, we move beyond traditional explanations and see how symbolic processes actively shape our interpretation of reality, defining boundaries, identities, interests, and actions in the evolving international context. The findings offer valuable insights for further research in critical IRT, foreign policy analysis, identity construction, and the role of language in global politics.

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COMPARATIVE ANALYSIS OF ECONOMIC DISCOURSE IN RUSSIA AND CHINA: TERMINOLOGY, METAPHORS, AND RHETORICAL STRATEGIES

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Keywords*: economic discourse, metaphorical language, rhetorical strategies, Russia-China analysis.*

In today's world, economic discourse shapes both policy-making and public perception of economic realities. Language transmits not only factual data but also ideological attitudes and persuasive strategies. Russia and China, as major economies with distinct cultural and historical backgrounds, exhibit unique discursive traits.

This study compares the economic discourse of Russia and China through terminology, metaphors, and rhetorical approaches. Following the view of T.A. Evtushina and N.A. Kovalskaya, economic discourse is seen as «A set of speech acts in the economic sphere, as well as oral and written texts or their fragments created by professionals, non-specialists, and journalists that reflect the realities of the economic world» [1].

Economic terminology is the foundation of professional communication and it reflects the development features of each country's economic system. In Russia, economic language blends Soviet-era terms like «five-year plan» (пятилетка), «state planning» (госплан), and «national economy» (народное хозяйство) with modern borrowings such as «management» «startup» and «GDP». Since the 2010s, terms like «diversification», «import substitution», and «economic sovereignty» reflect a shift toward autonomy, particularly after sanctions.

China's terminology combines traditional philosophy and adapted Western concepts. For instance, «xiaokang» (小康) refers to a moderately prosperous society rooted in Confucian ideals. «Zhongguoshi jingji» (中国式经济) or

«economy with Chinese characteristics», illustrates China's hybrid model of market tools and state oversight.

Other Chinese economic terms include:

- «Chuangxin jingji» (创新经济) — innovation economy,
- «Kexu xinchang» (可持续增长) — sustainable development,
- «Shehuizhuyi xiandaihua» (社会主义现代化) — socialist modernization,
- «Gaige kaifang» (改革开放) — reform and opening-up,
- «Shuang xunhuan» (双循环) — dual circulation,
- «Zhongguo meng» (中国梦) — Chinese dream,
- «Hexie shehui» (和谐社会) — harmonious society.

Both countries reflect their economic priorities through terminology shaped by culture and ideology.

Metaphors in economic discourse play a significant role as they not only explain complex economic processes but also shape how these processes are perceived by the public. Russia and China use different imagery that reflects national ideas about economic dynamics, risks, and development prospects.

Metaphors help simplify complex economic realities. In Russian discourse, military and crisis metaphors dominate: «economic war», «financial storm» «economic blockade» and «defense budget». These convey a narrative of resilience and struggle. Phrases like «sinking ship», «financial pyramid» and «currency swings» reflect instability and risk.

By contrast, Chinese economic discourse uses imagery of growth and harmony. Examples include:

- «River of reforms» (改革之河),
- «Rise of the dragon» (腾飞的龙),

- «Soft landing» (软着陆, ruǎn zhuólù),

- «Healthy development» (健康发展, jiànkāng fāzhǎn),

- «Path of socialism with Chinese characteristics» (道路, dàolù).

The metaphor of bamboo, which grows slowly underground before shooting up, symbolizes China's gradual but sustainable progress.

Rhetorical strategies in economic discourse define not only the style of presentation but also the ways of persuading the audience. In Russia and China, these strategies differ significantly, shaped by cultural features, political traditions, and views on the state's role in the economy. Russian discourse emphasizes contrasts and emotive framing. It often frames economic tensions in «us vs. them» terms. For example, President Putin in 2016 described sanctions as attempts to force Russia to «dance to someone else's tune» [8]. Such rhetoric conveys a narrative of national resistance and struggle.

Chinese rhetoric, however, emphasizes stability and collective progress. Xi Jinping's speeches mention entering a «new era» (新时代), eradicating poverty, and building a «xiaokang» society. Phrases like «inclusive growth» and metaphors such as «the sea cannot be harmed by a storm» underscore optimism and continuity.

Common rhetorical strategies in China include:

1. Appeal to collectivism — using terms like «the people» (人民),
2. Quoting traditional wisdom — e.g., «If you want to go far, go together»,
3. Softening tone — replacing «crisis» with «temporary difficulty» or «challenge».

Thus, Russia's discourse is emotionally charged and framed around opposition and endurance, while China's emphasizes harmony, continuity, and strategic development. These differences reflect broader political culture and national identity. Understanding these features aids translation, negotiation, and

cross-cultural communication. Future research may explore how digital media and globalization reshape economic discourse in both countries.

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THE INFLUENCE OF SMALL SOLAR FLARES ON PLASMA OSCILLATIONS IN THE LOWER ATMOSPHERE OF THE SUN

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Keywords*: oscillations, MHD wave, sun flares, lower atmosphere.*

In this paper, we analyzed the brightness images of Solar Dynamics Observatory (SDO) data in absorption lines 171, 304, 1600, 1700Å(AIA); Dopplergram(6173Å), continuum(6173Å) (HMI) for 4 active regions on the Sun. Each active region was considered during the period when a solar flare occurred in it.

It is assumed that a solar flare should lead to an increase in the plasma's own oscillations (5 min. fluctuations in the photosphere, 3min. fluctuations in the chromosphere) with the formation of a pronounced wave train [1]. By determining the time shift between the wave train, it is possible to determine the phase velocity of the propagating wave [2,3].

It was found that the analysis of intensity curves is not very well suited for these purposes, since the intensity of the absorption band only indirectly reflects plasma fluctuations through changes in the density of matter at a local point in

space. The presence of a expressed spike during the flash does not allow us to isolate amplified 5min fluctuations from it due to an error associated with the multiplicative effect, and the Q-factor of the fluctuations is so small that fluctuations can be observed after a spike in brightness.

It is suggested that the study of Doppler velocity curves instead of brightness curves could solve many problems associated with this objective. Firstly, when obtaining the Doppler velocity value, normalization to the intensity is performed; secondly, this parameter is related to the plasma motion and, therefore, directly reflects mechanical fluctuations in the system.

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SEASONAL DYNAMICS OF HORIZONTAL NEUTRAL WIND IN THE BAIKAL REGION BASED ON FABRY-PEROT INTERFEROMETER DATA AND VARIOUS VERSIONS OF THE HWM MODEL

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Keywords*: HWM, neutral wind, interferometer Fabry-Perot, upper-atmosphere.*

The present study is based on observational data of atmospheric airglow intensity collected using a Fabry–Perot interferometer (FPI), which has been deployed at the Geophysical Observatory (GFO) of the Institute of Solar-Terrestrial Physics of the Siberian Branch of the Russian Academy of Sciences (ISTP SB RAS). The observatory is located near the village of Tory, at geographic coordinates 52° N and 103° E, in Eastern Siberia, Russia [1]. This location is characterized by its proximity to mountain ranges and complex topography, making it a unique site for investigating atmospheric dynamics.

The Fabry–Perot interferometer is a high-resolution optical instrument capable of detecting small Doppler shifts in airglow emission lines, which are emitted by excited atomic and molecular species in the thermosphere. By measuring the spectral shift of these emissions in specific directions across the sky – typically zonal (east-west) and meridional (north-south) – the interferometer allows us to reconstruct the corresponding horizontal components of neutral wind in the upper atmosphere. These measurements are most reliable during the nighttime when airglow emissions are strongest and not obscured by solar radiation [2].

The primary goal of this study is to evaluate how empirical atmospheric models, specifically the Horizontal Wind Model (HWM), can reproduce the wind patterns observed over the East Siberian region. HWM is one of the most widely used global empirical models for describing horizontal neutral wind in the middle and upper atmosphere, covering altitudes from the lower thermosphere to the upper mesosphere. It is based on extensive datasets collected from a variety of ground-based and spaceborne instruments, such as radars, Fabry–Perot interferometers, and satellites [3].

There are multiple versions of the HWM model, each incorporating an expanding volume of data and algorithmic improvements. The version currently considered the most comprehensive is HWM14, which includes over three decades

of wind observations and significantly enhances the resolution and coverage of previous versions. However, older versions such as HWM93 and HWM07 are still actively used, particularly in comparative studies or for historical consistency in multi-decade modeling research.

A critical issue, however, lies in the geographical distribution of the input data used to construct the HWM model. The majority of the measurements underlying the model, particularly in earlier versions, were collected in the Western Hemisphere, including North America and parts of Europe. In contrast, the Eastern Hemisphere, and especially regions like Eastern Siberia, are underrepresented in the model's empirical database. As a result, applying HWM predictions to data from the GFO site raises important questions about the model's regional reliability and accuracy, and whether it can be trusted to describe atmospheric dynamics in such poorly covered areas.

In this work, we carry out a comparison between experimentally measured wind velocities and model-predicted values for the entire year of 2022, using three versions of the HWM: HWM93, HWM07, and HWM14. The analysis is restricted to the nighttime interval between 10:00 and 24:00 UT, when Fabry–Perot measurements are most effective. To better capture seasonal variations and assess the stability of the model's performance, the data were grouped into four seasonal periods, defined relative to solstices and equinoxes (spring, summer, autumn, and winter).

For each season, a set of averaged time series was constructed, representing the zonal and meridional components of the horizontal neutral wind. Experimental data were averaged over cloud-free nights only, and for each time point, the number of contributing observations was recorded. This allows us to estimate the statistical reliability of the averaged wind values and to assess the extent to which local conditions may influence the measurements.

From the analysis of these results, several important conclusions emerge:

- For the zonal wind component, there is partial agreement in overall trends between the model and observed values. However, significant deviations are

observed at various time intervals, and these discrepancies differ depending on both the season and the version of the model. For example, HWM07 shows the largest error in autumn, where its predictions deviate considerably from the experimental data.

- For the meridional wind component, the HWM93 version demonstrates relatively good agreement with the shape and structure of the observed wind profile in all seasons. Nevertheless, the predicted values sometimes show significant quantitative differences from the measured wind speeds—occasionally reaching a magnitude comparable to the wind speed itself. This suggests that although HWM93 captures the general variation pattern, it may still fall short in capturing absolute values.
- The prediction errors of the model vary both diurnally and seasonally, which indicates that none of the three versions of HWM can be considered universally accurate for the Baikal region. In fact, the best-performing version differs depending on the wind component and season. For instance, HWM07 may give the lowest error for the meridional wind in summer, while HWM14 could perform better for the zonal wind in the same period. This suggests that each model version has strengths and weaknesses, but none provides reliable predictions across all conditions.

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MULTIYEAR DYNAMICS OF THUNDERSTORMS IN THE IRKUTSK REGION AND NEAR-BAIKAL LAKE TERRITORY AGAINST THE BACKGROUND OF SOLAR ACTIVITY FROM 1997 TO 2023

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Keywords: *Irkutsk region, Baikal region, solar activity.*

A thunderstorm is a dangerous meteorological phenomenon associated with air convection, the formation of cumulus clouds, intense precipitation and the occurrence of lightning discharges. For a thunderstorm to occur, intense heating of the surface, the presence of water vapor in the air and conditions conducive to the initial rise of heated, humid air masses are necessary. Condensation of water vapor and freezing of droplets during air cooling due to its initial rise leads to the formation of clouds and the release of latent heat, which ensures further rise of air masses. The counter-vertical movement of droplets, snow and hail inside the cloud leads not only to the growth of droplets and precipitation, but also to the electrification of counter flows and the separation of electric charge by height inside the cloud. The magnitude of the separated charges can reach values at which the electric fields formed by the charges begin to exceed the threshold values of electrical breakdown in the air, as a result of which lightning discharges begin to occur.

There are three main ways in which thunderstorms form. When frontal air masses move along the earth's surface, warmer air masses containing more water

vapor, local or frontal, will rise higher, which will lead to their cooling and condensation of water vapor. Thunderstorms that occur as a result of such phenomena are called frontal. Intra-mass thunderstorms are formed as a result of uneven heating of the underlying surface, characterized by different albedo, humidity and soil vegetation, which provokes the occurrence of intense vertical convective air flows without an advective component. For the Baikal region, it is important to highlight cumulonimbus thunderclouds formed as a result of the movement of air masses to the slopes of mountains and mountain ranges. Thunderstorms formed in this way are called orographic. Since the second half of the 20th century, the global surface air temperature has increased by 1.1 °C [1]. Due to a number of positive feedbacks and local effects, the surface air temperature in the high latitudes of the Northern Hemisphere has increased faster than the global average: in particular, in Russia by 2.5 times since 1976 [2]. The temperature regime of the middle troposphere has changed: in particular, the vertical gradient has increased with an increase in the surface air temperature. Warming leads to an increase in the moisture content of the atmosphere. An increase in surface air temperature and air humidity, as well as an increase in the vertical gradient, enhance atmospheric convection and can lead to an increase in the frequency of strong convective phenomena in the atmosphere. Therefore, the study of thunderstorm activity over the territory of the Irkutsk region against the background of climate change is an urgent task. One of the factors on which thunderstorm activity depends may be solar activity (SA). For example, in [3], the authors, examining variations in thunderstorm VLF noise in summer and their connection with solar activity indices over the territory of Yakutia, come to the conclusion that they are inversely related. The work emphasizes the wide range of such correlations, from the east of Siberia to the African world thunderstorm center. This connection is explained through a channel that has a global character - the planetary electric circuit [4].

Also, in [5], the conductivity of the global atmospheric electric circuit is described, taking into account the degree of its ionization by the flow of charged

particles of various natures, in particular solar cosmic rays. The results of measurements of the vertical component of the electric field and pole conductivity, carried out according to weather balloon data during a solar proton storm, are presented. A conclusion is made about the connection between space weather parameters and parameters affecting the formation of lightning.

The Irkutsk region directly borders Yakutia, so it is interesting to consider the influence of the already studied factors on the dynamics of thunderstorms near Lake Baikal. The number of days with thunderstorms was used to analyze thunderstorm activity, since such a criterion was used in previously obtained and summarized data for the Baikal region [6]. Data on the number of thunderstorms were obtained from the network of meteorological stations of the Irkutsk UGMS and compared with the SA index F10.7.

The work [6] presents statistical data on the number of days with thunderstorms from 1900 to 1970 for the stations Irkutsk, Bratsk, Bayanday in the periods: from 1931 to 1950, from 1920 to 1970, from 1900 to 1970. Also, the statistical parameters are given: standard deviation σ, asymmetry coefficient A, excess coefficient E. The data shown by Filippov A.Kh. characterize the region in the area of the Bayanday meteorological station as more convective. A smaller number of days per year with thunderstorms is observed at the Irkutsk meteorological station, which is interpreted by the author by the close geographical location with Lake Baikal, over the cold surface of which in the summer months there is a temperature inversion, which hinders the convective movement of air. The author [6] provides maps of the spatial distribution of the number of days with thunderstorms, where an area of reduced number of days with thunderstorms is highlighted in the Angara Ridge zone, where the Bratsk meteorological station is located.

At the stations and posts of the Irkutsk UGMS, thunderstorm observations are carried out during regular meteorological observations every 3 hours, as well as between the periods. The start and end time of thunderstorms is recorded. In this work, observation data were used and the number of days with thunderstorms was

calculated from 1997 to 2023 for all operating meteorological stations. The obtained values were compared with the data obtained for the period from 1900 to 1970.

As a characteristic of solar activity, the values of the F10.7 index were used in this work. Which is a flux of radio emission with a wavelength of 10.7 cm. The data on the values of the F10.7 index are presented in the public domain at the link [7], integral annual values were used in the work.

At the first stage of the study, we compared the average number of days with thunderstorms for the period 1971-2023 with previously obtained data [6] for the Irkutsk, Bayanday, and Bratsk stations. The operator extracted data for 1971-1996 from the TM-1 meteorological observation logs of the Irkutsk UGMS and compiled a spreadsheet for subsequent calculations of the average value per year and its standard deviation (SD) for the specified period. Data for the period 1997-2023 were extracted from the already digitized meteorological data archive, on the basis of which the average and SD were then calculated for all years of the specified range. The results obtained are presented in Table 1.

	Source: [A. H. Filippov, 1974]		According to data from the meteorological observation logs TM-1 of the Irkutsk UGMS		According to the analysis of digital archives of the Irkutsk UGMS	
	1900 – 1970		1971 - 1996 (from April to September inclusive)		1997 - 2023	
	N	Σ	N	σ	N	σ
Irkutsk	16.0	4.75	14.0	3.69	17.5	4.4
Bayanday	18.4	5.33	17.6	5.86	14.4	5.1
Bratsk	16.7	5.21	Данные не собирались		22	5.1
Average values	17	5	15.8	4.77	17.9	4.8

Table 1. Summary data on the average number of days with thunderstorms (N) and the standard deviation of days with thunderstorms (σ) for the period from 1900 to 2023

Since 1900, there have been no significant changes in the number of days with thunderstorms for these stations. For all stations, the average number of days with thunderstorms during the warm period of the year is about 15 days. Note that for Irkutsk and Bratsk over the past 20 years, the number of days with thunderstorms has increased, and for Bayandai, on the contrary, it has decreased, but the differences in the number of days with thunderstorms for the period 1900-1970 and 1971-2023 do not exceed the standard deviation, which indicates statistically insignificant changes. The impact of solar activity is global and weakly expressed, so with a high degree of probability, the manifestation of this impact for an individual station will be insignificant. Therefore, to analyze the relationship between thunderstorms and solar activity in the Irkutsk region and the Baikal territory, it makes sense to consider the integral regional characteristic. The data from all weather stations in the Irkutsk region stored in the already digitized archive (1997 - 2023) allow us to calculate the average number of days with thunderstorms and the standard deviation of this parameter for all weather stations for a single year. The values of the calculated parameters against the background of the normalized values of the F10.7 index are presented in Figure 1.

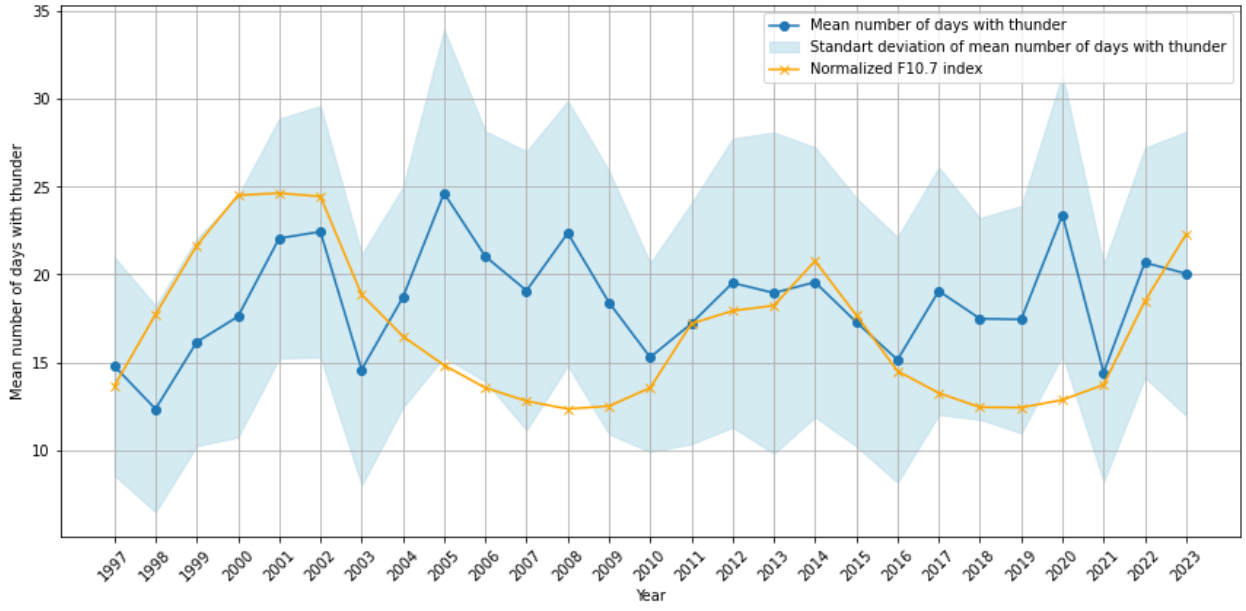

Figure 1 - Average number of days with thunderstorms for all weather stations of the Irkutsk UGMS, average value of standard deviation and normalized index F10.7

The course of the normalized index F10.7 has a pronounced character, reflecting the dynamics of solar activity for the period under consideration. The maxima of the 23rd, 24th and 25th cycles of solar activity are quite clearly traced. The dynamics of the average number of days with thunderstorms in the region, although experiencing some variations, is at a constant level, without a trend component. The minimum values of variations in the number of days with thunderstorms tend to group in the growth and decline phases of solar activity, while the maximum number of days with thunderstorms is observed both in the maxima and minima of F10.7.

The digitized archive (1997 - 2023) of data from all weather stations in the Irkutsk region allows us to construct a spatial distribution of the number of days with thunderstorms (Fig. 2), which can be compared with previously obtained information [6].

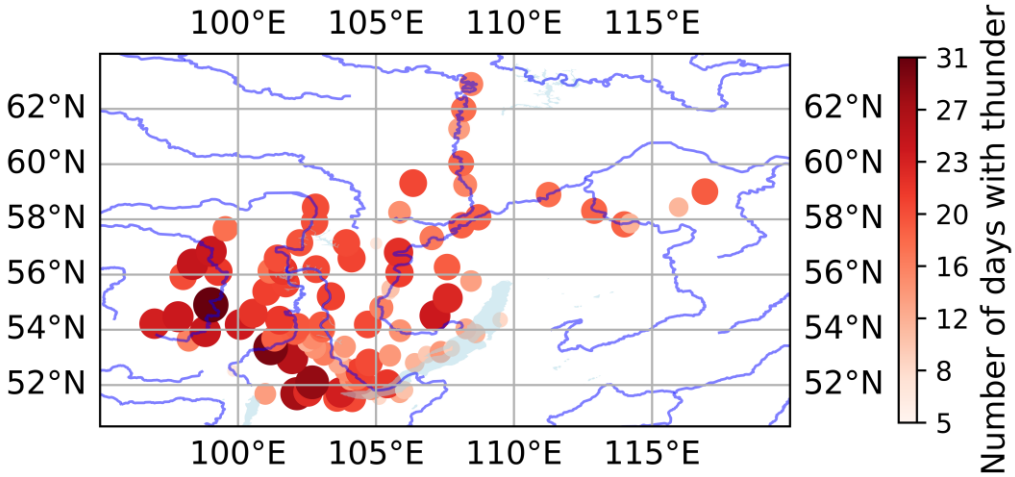

Figure 2 - Average number of days with thunderstorms at weather stations of the Irkutsk UGMS.

It is evident that the spatial distribution of the number of days with thunderstorms is primarily determined by physical and geographical conditions. Mountain ranges (Sayan, Pribaikalsky Mountains) create favorable conditions for the development of convection due to the orographic rise of air masses. Northern territories, such as the Katangsky region, are characterized by minimal thunderstorm activity - less than 10 days per year due to the prevalence of stable

air masses and less surface heating. Central and southern regions, including Irkutsk, have average rates - 15-20 thunderstorm days per year. Frontal sections play a significant role here.

During the work, an analysis of the dynamics of thunderstorm activity from 1900 to 2023 was carried out according to data from [6] and meteorological stations of the Irkutsk UGMS, as a result of which no significant changes in the number of days with thunderstorms were revealed. The spatial distribution shown in the work from 1997 to 2023 is consistent with works [6] and [8], as well as with the analysis of variations in convective instability indices in work [9]. Analysis of the relationship between the number of days with thunderstorms and the F10.7 index showed that we observe peaks of thunderstorm activity at the maxima and minima of solar activity. In other words, on average, the number of thunderstorms correlates with variations in the F10.7 index with double the frequency.

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UDC 81’255.2

SUSTAINABLE DEVELOPMENT AND ESG IN MODERN GEOGRAPHICAL RESEARCHES

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***Keywords**: sustainable development, ESG, geography, corporate, SDG.*

Sustainable development is understood as development in order to meet human needs and aspirations, ensuring the development of the current generation, but not to the detriment of the interests of future generations to satisfy their own needs [1]. This term has become widespread after the report to the development of the UN International Commission on Environment and Development [2]. Key aspect of this report was «Major global environmental problems are primarily the result of southern poverty and unsustainable consumption and production patterns in the north» [2].

Sustainable development includes three main components: the first component (ecological) proceeds from the key task of modern civilization, namely: preservation of the environment in conditions of preservation and development of

consumer society. Resources are managed in such a way that production opportunities for the future are preserved and a steady income of services provided by resources is maintained; minimum conditions of ecosystem stability over time are maintained.

Second component (social) define SD as a process aimed at implementing mainly socio-economic tasks facing the globalizing world. According to E.V. Barbier, the main goal of sustainable economic development is to reduce the absolute poverty of the world's poorest countries through their long-term and reliable supply, minimizing the depletion of natural resources, environmental degradation, cultural disruption and social instability [3].

The third component (economic) approach to the definition of the concept of "sustainable development" believes that SD is support for the growth of the overall level of economic wellbeing, which can be represented as the level of economic well-being per capita.

In order to ensure the implementation of the concept of sustainable development The UN Sustainable Development Summit in 2015 adopted 17 Sustainable Development Goals (SDG). SDG are divided into three main groups: environmental conservation such as conservation of terrestrial and marine ecosystems; social goals such as no poverty, zero hunger; economy and governance goals such as responsible consumption and production, decent work and economic growth.

ESG concept is a system of management principles in company involved in solving environmental, social and governance problems. ESG - the company’s strategy, which provides a transparent management system, responsible attitude to nature and measures for its conservation, as well as taking care of the people who interact with the company (staff, communities in cities and regions of presence).

Corporate geography is a study of the spatial structure and behavior of business corporation. The study was coined in the 1960s [4]. Currently, corporate geography is a developing area of research. Some areas of corporate geography: spatial study of company growth; studying the spatial structure of companies;

exploring the links between the corporation and the environment; the study of links within multifunctional companies, including links between production and non-production units.

Corporations are involved in the sustainable development agenda by implementing their ESG-strategies. For research in the field of corporate geography, involvement in the implementation of the SDG-agenda is important. In order to identify projects implemented by companies, researches often examined ESG-reports. Corporate sustainability reporting guidelines and frameworks, such as the Global Reporting Initiative (GRI), International Integrated Reporting Council (IIRC) and Global Compact (GC), encourage corporations to address the SDGs in their reports [5].

The analysis of such data allows us to obtain information about the company's social investments, environmental projects, management system, and interaction with indigenous minorities in the territory.

The most relevant SDG-goal in the context of research objectives of corporate geography is sustainable cities and communities. A sustainable city balances environmental, social, and economic needs. This aims to provide residents with a high quality of life while safeguarding resources for future generations. Corporate geography studies how corporations achieve this SDG-goal through their ESG-strategies [6].

Currently, we can observe how corporate geography explores corporate sustainability policy in the context of its objectives, but corporations also use the achievements of corporate geography to form and improve their strategies in relation to territories of presence or responsibility.

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SUSTAINABLE DEVELOPMENT OF FLOODPLAIN AREAS IN THE SELENGA RIVER DELTA

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Keywords*: Selenga river delta, Hydrological risks, Seasonal inundation, Orthophoto mapping, fluvial erosion.*

The process of constructing buildings within floodplains is a complex and multifaceted undertaking that necessitates a meticulous examination of numerous factors. River floodplains are distinguished by elevated levels of humidity, recurrent flooding that occurs on a seasonal basis, and distinctive geological characteristics. The reduced construction cost renders them appealing for a variety of construction projects; however, they also present substantial challenges for designers. A pivotal element in this regard is the water regime. River floodplains are susceptible to recurrent flooding, necessitating specialised measures to safeguard buildings and infrastructure. Villages and settlements constructed in the 1990s, during the low-water period, are now at risk 30 years later due to the increasing water content of rivers. It is evident that almost all sectors of the

economy in our country, including road transportation and agriculture, are engaged in the understanding of the regularities of channel deformations.

It is an established fact that the Republic of Buryatia suffers significant economic losses on an annual basis as a result of flooding. During the summer season of 2024, significant precipitation resulted in the inundation of residential dwellings, outbuildings, agricultural land and vegetable plots. The total number of flooded areas in Buryatia is already 510, affecting 1,200 residents. The most challenging scenario is currently unfolding in three districts of Buryatia: Mukhorshibirsky, Tarbagataysky and Zaigrayevsky. In the latter, during nocturnal hours, another village – Chelutai – began to flood. In the aftermath of the incident, a total of eleven residents were expeditiously relocated to a designated temporary accommodation centre. In the vicinity of the federal highway Ulan-Ude - Chita, a substantial portion of the infrastructure was destroyed due to a landslide. Consequently, restoration efforts were initiated, and the affected area underwent reconstruction for a period of several days. In the event of an emergency, a designated detour route was established for vehicles, and provisions such as food and water were made available to individuals who elected to remain in place [3].

In the field of construction theory, a distinction is often drawn between active and passive structures that exert an influence on river flow and its dynamics. Structures of this nature encompass bridges and oil crossings, in addition to bank protection structures, dams and weirs [1].

Since 2018, the Russian Federation and Mongolia have engaged in deliberations concerning the construction of hydropower plants on the tributaries of the Selenga River (the Mongolian portion of the basin). A number of these plants were conceptualised during the Soviet era. The primary objective of these HPPs was to supply electricity to promising developing areas. However, following the collapse of the USSR, the ambitious project was abandoned. It is the opinion of certain experts that these HPPs will resolve the issue of catastrophic floods and floods by accumulating runoff in reservoirs. However, the impact on the ecosystem of Lake Baikal remains to be seen. The question remains unresolved. In February

2025, an agreement was reached between scientists from the Mongolian State University and other relevant parties concerning the formulation of a unified concept for the utilisation of water resources in the transboundary Selenga Basin [2].

The Selenga Delta can be regarded as the final link in the basin system, as it accumulates all natural and anthropogenic 'processes' occurring in its catchment area. The Selenga 'collects' water from an area of approximately 447,000 km² (the main part of the Baikal basin). The estuary is subject to the influx of sediment and pollutants from a variety of sources, including the Orkhon and Egiin-Gol rivers in Mongolia, as well as Buryatia.

Figure 1 below presents an orthophoto of one of the observation points in the Selenga River delta. The study is grounded in a DJI Mavic 3 Pro Mini UAV survey conducted during fieldwork in 2024. The figure on the right presents a combined mapping scheme with data from the bathymetric multibeam echo sounder survey.

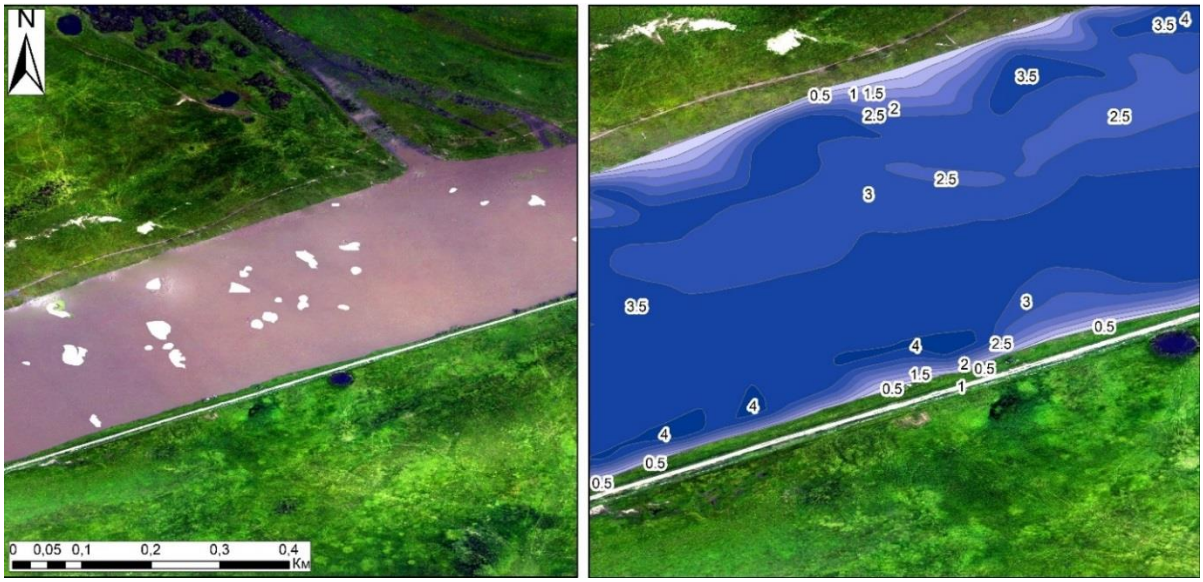

Figure 1. A bathymetric survey of the section of the Levoberezhnaya river channel

In order to estimate vertical channel deformations, multi-temporal depth data at a fixed hydraulic reservoir of the Levoberezhnaya channel was utilised (see Fig.

2).

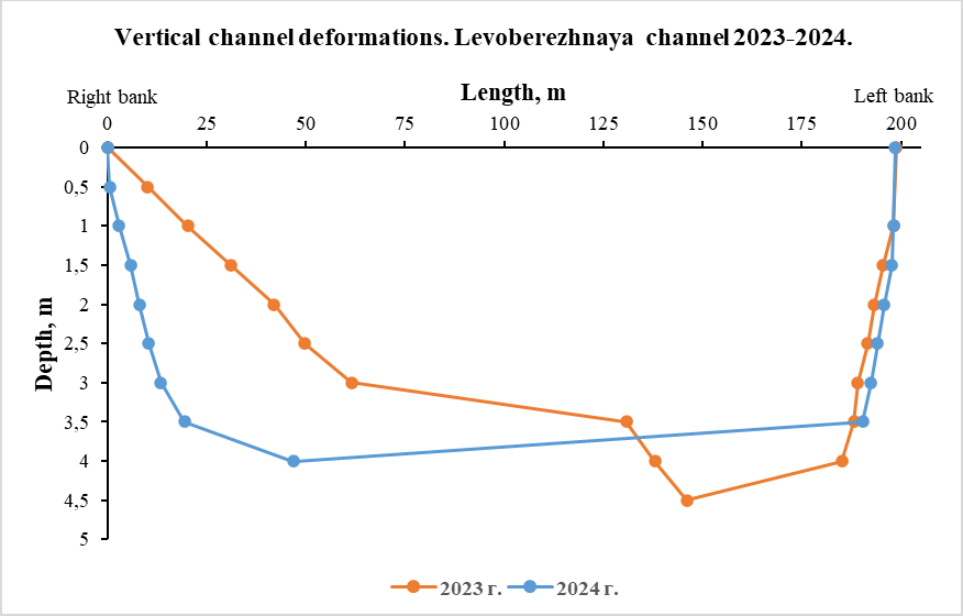

Figure 2. Vertical channel deformations. Levoberezhnaya channel 2023-2024

The figure indicates that bed scour was present on the right bank, measuring approximately 2.5 metres, while river sediment was deposited on the left bank. In order to construct a scour limit profile, it is necessary to establish a greater number of stations and to undertake an assessment of the planned channel deformations, based on retrospective analyses. Subsequent studies will be enriched by the integration of contemporary cartographic resources and sediment discharge values.

The Selenga Delta constitutes a pivotal component of the Baikal Natural Area, and has been formally recognised by the Ramsar List of Wetlands of International Importance. It is imperative that continuous monitoring is carried out using Geographic Information System (GIS), remote sensing and mathematical modelling. Assessment of channel deformation and sediment flow in the Selenga River delta is of importance for Baikal ecology, sustainable development of the region and minimisation of anthropogenic risks.

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UDC 332.13(571)

ECONOMIC GEOGRAPHY OF CROSS-BORDER COOPERATION: A CASE STUDY OF THE RUSSIAN FAR EAST AND TRANSBAIKALIA BORDER REGIONS

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Keywords*: cross-border interaction, region studies, foreign investment, economic geography, Russian-Chinese cooperation.*

One of the ways of assessing the rate of cross-border cooperation is the investigation of foreign-owned companies. This method is used not only in economics, but also in the field of economic geography. See, for example, the research [1] to gain an understanding of this method applied by a geographer to the study of post-socialist economies.

We have chosen, for this paper, to define the area of our research as the border regions of the Far Eastern Federal District (that now includes Transbaikalia). There will be two primary objectives of our analysis. The first is to look at the spatial distribution of Chinese-owned companies in the border regions, and the second is to determine companies' economic activity. The data was gathered through [2] and [3].

The figure 1 shows the geographic distribution of Chinese companies in the defined border zone. The biggest share of Chinese companies is located in the landlocked regions: Zabaikalsky Krai (85% of all foreign and joint ventures registered in the region are Chinese), Amur oblast (92%) and Jewish Autonomous Oblast (89%). The coastal regions of Khabarovsk and Primorsky Krai, on the other hand, are characterized by bigger presence of companies from other countries than China (with share of Chinese companies being 65% and 49%, respectively).

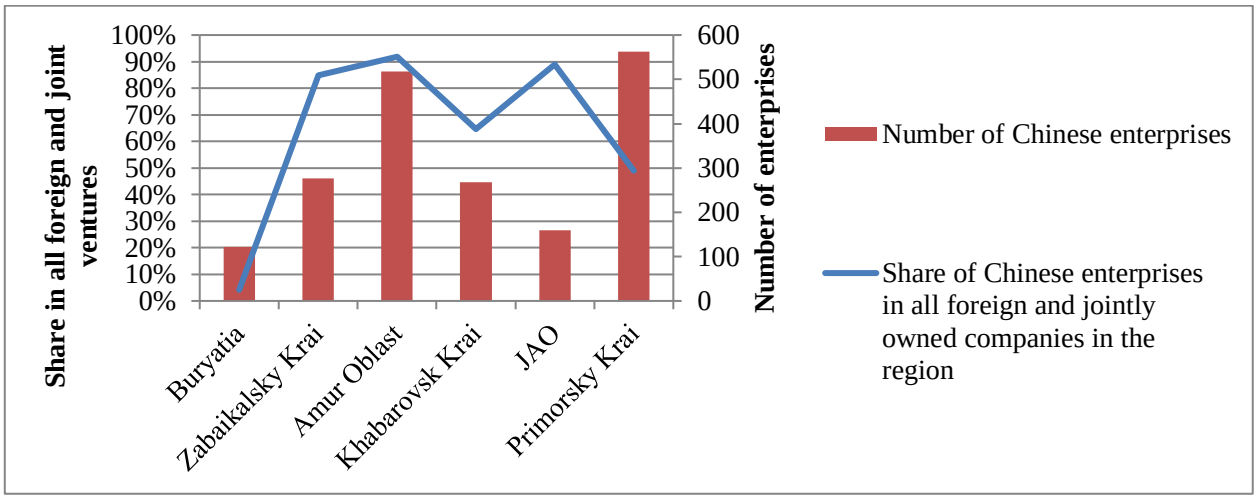

Figure 1. Chinese enterprises in the Far Eastern border regions (as of 2023)

The number of companies itself is reflective of several major factors. One such factor is the investment projects, which is seen in the case of Amur Oblast, where 518 Chinese-owned and jointly owned (Russian-Chinese) companies are located. The other factor is the development level of transportation and storage infrastructure in the case of Primorsky Krai, the eastern-most point of Trans-Siberian Railway, from where the most important sea routes in the Asian Russia emerge, and where 562 such companies are located. Republic of Buryatia is the

only region in the Far Eastern Federal District not bordering China, most of the foreign companies in the republic are Mongolian.

The distribution by companies' main activity (figure 2) has very logical economic geographical explanation.

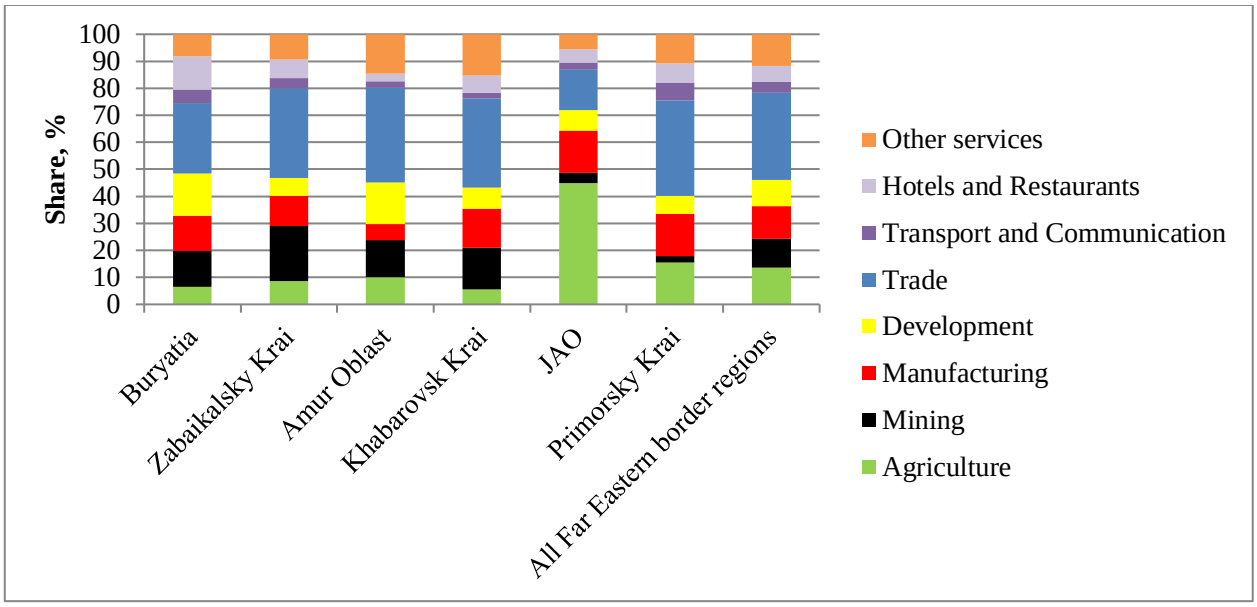

Figure 2. Chinese enterprises by main economic activity (as of 2023)

The most extreme example here is Jewish Autonomous Oblast, with the least share of companies working in services and the biggest in agriculture among all the territories. It is the result of both the natural factor and the low economic-geographic capacity of the region (with its small population and relatively less economic development leading to the small market). On the contrary, the biggest share of enterprises working in services is in Primorsky Krai, which has the best geographic location from the international interactions perspective, but is lucking in mining resources. Mining resources are the economic specialization of Zabaikalsky Krai, which also found clear representation in the results. Similar conclusions can be drawn about almost all other types of economic activity in all of the regions. Somewhat of an exception is trade, it being represented almost equally between the regions is mostly explained by the fact that international companies are generally more likely to work with this type of economic activity, rather than by any geographic factor.

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UDC 81-114.2

SPECIFICITY OF TRANSLATION OF PROFESSIONALISM AND NOMENCLATURE NAMES OF THE OIL AND GAS INDUSTRY AS A LINGUISTIC PROBLEM

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Keywords: *professionalism, specialized vocabulary, accuracy of translation.*

The topic of translation of professional terms and nomenclature names of the oil and gas sector is one of the most urgent and complex linguistic problems, due to the high specialization of terminology, interlinguistic differences in industry systems and the functional importance of accurate reflection of technological processes.

The solution of this problem requires not only knowledge of the language system, but also a deep understanding of the technological context. features of

industry terminology and standards. Practice shows that incorrect translation or underestimation of these aspects lead to misunderstanding of documentation, risks in operation and errors in interstate communication [3].

Professional vocabulary is formed under the influence of interlingual borrowings, morphological structures, often compound words or abbreviations, and semantic transformations [1]. For example, words like "wildcat well", formed by metaphorical transference, based on resemblance to wild cats, or "Christmas tree", based on resemblance to a Christmas tree, the term "drill rig" is a device used for drilling oil wells. In Russian, its equivalent is "drilling rig", which is a common name. However, when translating technical documentation, it is important to accurately convey its functional and sectoral features, which requires knowledge of both English and Russian professional vocabulary.

The key point of the problem is the translation of nomenclature terms, which are often represented by abbreviations, for example, "FPSO" (Floating Production Storage and Offloading). In Russian, their equivalent is "floating production and offloading unit", which is a long definition in structure. In cases where there are no standardized analogues, transcription or tracing papers are used, which requires knowledge of industry standards and conventions [3].

Translation difficulties are also due to linguistic differences: English builds terminological units through word and abbreviation combinations, while Russian often gives them a more detailed form. For example, "oil well" is translated as "oil well" and "production platform" as "oil platform". Incorrect translation, such as confusion about the accuracy of names, can lead to serious consequences in project documents, which emphasizes the relevance of the problem [2].

Based on the analysis of oil and gas texts, the main types of complexity in translation were identified, which are illustrated in pictures 1 and 2. The analysis shows that in order to successfully solve linguistic problems in the translation of such terms, it is necessary to use special industry glossaries, consult with professionals and apply modern translation methods. In the absence of exact

analogues, new words are created or English terms are calculated, which makes it possible to preserve the semantic and industry accuracy [1].

Picture 1. Structure of professional terminology in the oil and gus industry

Picture 2. Prevalence of methods of forming professional vocabulary

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THE IDEA OF DIVERSIFYING THE TEACHING OF RUSSIAN TO CHINESE MEDICAL STUDENTS

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Keywords: *language of specialty, language of teaching, metalanguage of medical science, international students, diversification approach.*

The strategic goal of attracting international students to Russian educational institutions depends largely on the established system of teaching Russian as a foreign language. The effectiveness of this system is linked to the development of international students' professional and linguistic competence. It is based on the Russian language proficiency requirements for foreign students to obtain professional education and on the personal needs of international students.

The personal interests of most foreign students, like those of Russian applicants, are primarily related to the desire to acquire a profession that will help them become financially independent and self-sufficient in the future. Some argue that the language and culture of the country they study attracts foreigners: "Many students only encountered the Cyrillic alphabet after studying in Russia, so they are interested in the history of its origin and development, the numerical values of Old Church Slavonic letters, and many other fascinating historical and contemporary facts." [5, p. 131]. Experience working with international students shows that practical motivation is increasingly important for foreign students – students want to realize the opportunity to obtain a professional education and become competent specialists. The Chinese Ministry of Education considers comprehensive improvement in the quality of education and its level of modernization, strengthening the ability of personnel to serve the state and the people, and enhancing their competitiveness in the international arena among its key objectives. [1, p. 146].

Chinese students, who have been increasingly attending Russian educational institutions in recent years, are looking for a highly organized educational process to obtain their degree. In 2019, the Chinese Ministry of Education proposed key areas for structuring the humanities: "professional optimization, improving the quality of the curriculum, and innovation in models." This idea was previously

expressed at Hiram College in the United States, where they advocated the integration of higher education with modern information technology methods, the reorganization of traditional humanities majors, and the creation of a new model for interdisciplinary humanities education and specialist training.

Chinese students coming to Russia for master's and postgraduate programs are becoming increasingly well-prepared in their respective fields of study in Russian. For example, the "Methodological Guide for Students Studying Russian in Higher Education Institutions" states that the undergraduate Russian language program at colleges and universities lasts 4–6 years (150–180 credits; 2,400–2,900 academic hours). Meanwhile, the professional Russian language curriculum, in addition to general foundation courses, devotes considerable time to professional foundation courses, professionally focused courses, and practical training internships [9].

Teaching a medical specialty in a foreign language is in itself an educational challenge, as "medicine is a unique, multifaceted human activity that encompasses the physician's ideological, moral, and environmental culture. Medicine and culture are intertwined in all their facets and address a single, shared goal—the quality of human existence." [3]. Thus, by setting tasks that are specifically linguistic and professional, we go beyond the boundaries of these sciences, into the sphere of national philosophy and culture.

Medicine has traditionally been a key scientific field for China. At a 2018 meeting of the Department of Higher Education of the Ministry of Education of China, it was stated that, in order to develop higher education and cultivate top-notch talent, it is necessary to comprehensively promote the development of new medicine and new humanities, in addition to engineering and agriculture. [8, p. 105].

The interdependence of linguistic proficiency and professional competence is becoming increasingly important in the context of all national and educational challenges, as well as due to the specific nature of the medical field itself. In a context where students urgently need professional skills and abilities, as well as the

personal qualities that characterize them as competent specialists, we need to reconsider our approaches to professional Russian language acquisition.

The educational process aimed at developing professional linguistic competence typically begins at the pre-university stage. It involves the use of organizational forms and scientific and methodological support typical of higher education in the context of the acquired specialty. It has been noted that "the disciplines that comprise the pre-university stage of developing professional linguistic competence in international students at the university are primarily focused on mastering language and speech material, but do not provide the necessary professional orientation." [4, p. 4]. The reason cited is the “contradiction between the need to introduce a competency-based approach into the university’s educational process and the lack of an adequate model for developing the professional and linguistic competence of foreign students at the university [4, p. 5].

Meanwhile, in the absence of such a model, teachers must achieve progress in all aspects of speech development: teach reading and professional translation using a dictionary; create a linguistic foundation for subsequent foreign language learning, taking into account the specifics of the chosen profession; teach the rules of pronunciation, word formation, and sentence structure; and perform tasks in the area of systematization of language skills.

Achieving the goal of using a foreign language in accordance with the communication situation within a certain field of activity in the most effective and efficient ways is associated with the idea of diversification in education [2]. As a fundamental pedagogical principle, diversification contributes to the creation of objective conditions for the expansion of professional knowledge, and in the context of a systemic-structural analysis of educational programs, it relates to the variability of program components and the strengthening of individualization of learning.

To formulate methodological and pedagogical objectives for teaching the metalanguage of medical science, it is necessary to have information on the state of

this scientific field and relevant specialties in the students' home countries, as well as the knowledge and qualification requirements for industry representatives. The gap between the state of the professional landscape in medicine in China and Russia, and its specific features, are crucial in developing training programs and shaping approaches to teaching.

It is necessary to take into account and understand the professional communication needs of foreign applicants, which are based on national characteristics of professional communication models. Selecting specialized language materials based on professional standards in the country of study, in a volume and in accordance with the language proficiency level, is a serious methodological challenge that must be addressed systematically and consistently.

Insufficient knowledge of Russian terminology, the linguistic characteristics of scientific style, and the specific methods of organizing medical documents in the Russian medical field affect the quality of analysis and assimilation of perceived (read and heard) information by Chinese students. A variety of presentation formats for medical information will significantly improve the comprehension of professional content.

Difficulties in understanding medical terms due to the presence of non-equivalent vocabulary are "confirmed by the negative search result in the Chinese-Russian dictionary or the diversity of variants in the Chinese-Russian corpus of texts" [7, p. 32]. The variety of lacunae in medical terminology (motivated, generic and specific, intralingual) cause difficulties in forming a connection between a term and its equivalent in the native language [6, p. 86].

There is an obvious need to develop a cognitive portrait of the object of the medical worldview in foreign students, taking into account its conceptual sphere, based on lexical competence and the ability to create a secondary text in the language of the specialty.

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USING MEDIA TEXTS FOR ENHANCING STUDENTS' CRITICAL THINKING IN ENLGLISH LANGUAGE LESSONS

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The ubiquity of media content and the quick development of digital communication channels have drastically changed the educational landscape. Students today must continually engage with multimodal information streams, which makes media literacy and critical literacy essential skills of 21st century. A useful methodological technique for developing analytical abilities, increasing language proficiency, and encouraging reflective attitudes toward information is the integration of media texts into ELT. Such integration is extremely pertinent given Kazakhstan's educational modernization ambitions and supports the country's objectives of fostering media and functional literacy in secondary school pupils [5], [7].

Media texts – including news articles, videos, advertisements, social media posts, and various digital formats – function not only as authentic linguistic resources, but also as catalysts for cognitive engagement. Utilizing these texts enables students to analyze the author's objectives, recognize manipulative techniques, compare perspectives, and evaluate the reliability of sources [1]. Previous mixed-methods research conducted in Kazakhstani schools has demonstrated that the use of media texts results in significant enhancement in pupils' argumentative abilities, evidence evaluation, and skill in differentiating between facts and opinions [6].

The multimodality of media texts is what gives them methodological value. Differentiated learning is supported and comprehension is improved by visual, verbal, and auditory components. Media resources promote dialogic reflection, peer cooperation, and active learning when included into task-based learning framework. When discussing real-world media content, teachers say that students are more motivated and engaged, because it links what they learn in the classroom to their daily digital experiences [3], [8].

Nevertheless, the situation in Kazakhstan also poses various difficulties. Initially, media literacy has not been completely integrated into national educational curricula and teacher development initiatives. Secondly, digital disparities continue between urban and rural schools, impacting access to quality media resources. Third, numerous educators do not possess didactic frameworks for the systematic incorporation of media texts into language teaching. These challenges highlight the need for creating national guidelines, teacher training programs, and collections of pedagogically tailored media resources [4], [6], [7].

Regardless of these difficulties, the possible advantages are considerable. Instruction that uses media helps pupils learn to make good decisions, get better at not believing false information, and know how culture affects communication around the world. Also, this way of teaching matches the plans of Kazakhstan, which highlight being good with technology, learning foreign languages, and thinking carefully as important educational goals [5]. Because digital media keeps changing how we communicate, knowing about media is now a key part of teaching English well.

In conclusion, we note that incorporating media texts into ELT is a powerful and necessary teaching strategy to develop students' critical thinking and media literacy. To maximize its impact, Kazakhstan's education system should prioritize building methodological frameworks, developing teacher training, and supporting schools with technical and learning resources. The systematic use of media texts contributes to the development of critically thinking, digitally competent and world-oriented young generation.

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