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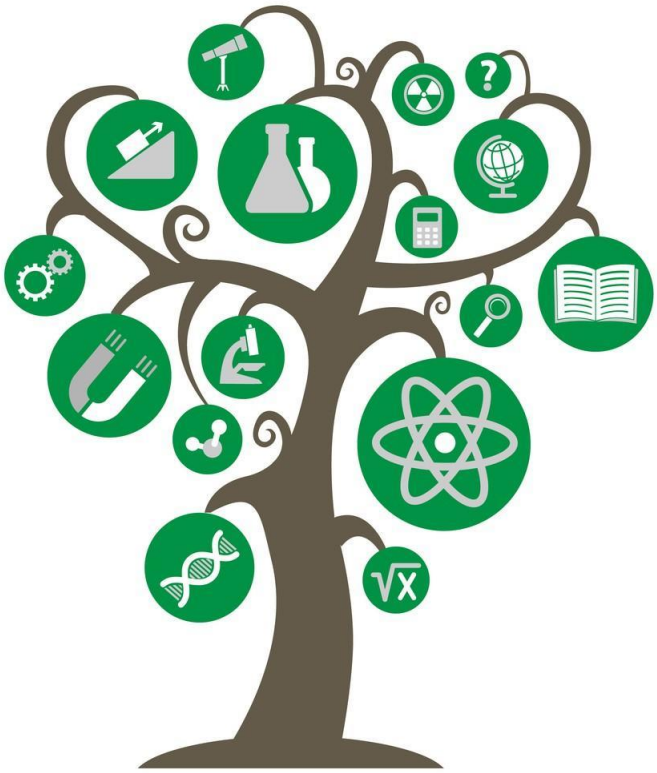

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«Science Present and Future: Research Landscape in the 21st century»

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Содержание

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UDC 551.51

STUDY OF THE LARGE-SCALE AIR-SEA INTERACTION EL NINO PHENOMENON

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ABSTRACT: The article is a review of present ideas about El Niño Southern Oscillation (ENSO) generation.

KEYWORDS: Oscillation, models, climate, trades.

The El Nino-Southern Oscillation (ENSO) is an ocean-atmosphere interaction occurring in the equatorial Pacific Ocean but has significant climatic impacts around the world. The ENSO identifies features of observed regimes that may result in cases in different countries or loss of life. The ability to effectively model and predict the ENSO one or more seasons ahead is of great importance, but requires special attention. The main objectives are the diversity, complexity, unevenness and totality of the ENSO.

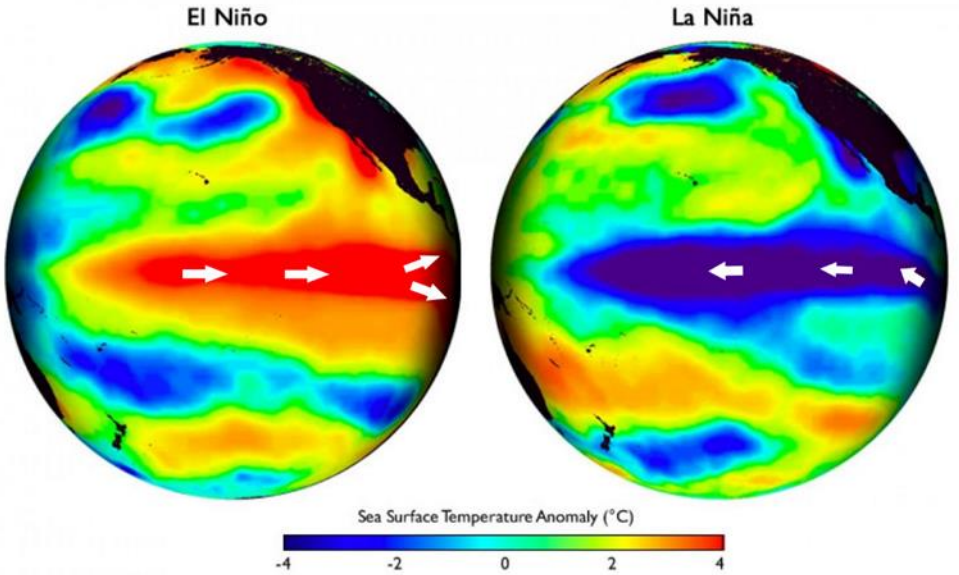

Figure 1 – Conditions in the tropical Pacific during El Nino (left hand picture), conditions during La Nina (right hand picture)

The variability of the phases of the phenomenon, the influence of this phenomenon on the behavior of climate around the world are briefly considered. In the review there is also a discussion about El Nino Modoki (pseudo-El Nino). Due to the ENSO's significant impact on the global climate and economy,

accurate ENSO modeling and forecasting is essential. The review also briefly discusses various models with varying degrees of complexity that are currently known.

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WAVES IN THE MAGNETOSPHERE AND THEIR INTERACTION WITH THE PLASMA

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ABSTRACT: Overview of wave phenomena in the magnetosphere and their effect on the plasma.

KEYWORDS: plasma, Alfvén waves, stable auroral red arcs, SAR.

Wave phenomena are an important part of magnetospheric physics. However, different plasma conditions in its different regions do not allow to create a complete global model of the magnetosphere. Thus, consideration of the phenomena is usually done in small regions and in narrow ranges of physical parameters.

The consideration of magnetospheric oscillations is predominantly carried out using two different approaches: magnetic hydrodynamics (MHD) and kinetic method. There are three main types of waves in MHD-plasma. We focused on the consideration of the so-called Alfvén waves in two types of plasma (“cold” and “warm”), as well as in the transition layer between them. This layer is most likely located in the plasmapause region at a distance of approximately 25,000 kilometers from Earth.

Thus, the spatial structure of the certain type of plasma waves near a dissipative layer is examined [1]. The type of dispersion for this waves changes inside the dissipative layer: from ”cold,” when the transverse (across the magnetic shells) wavelength is determined by the electron skin depth in plasma, to ”warm” dispersion, when the wavelength is determined by the ion Larmor radius.

In the dissipative layer, the Alfven wave velocity is close to the thermal velocity of background plasma electrons. As a result, the kinetic waves in this layer are completely damped, transferring their energy to the electrons. This effect is called Cherenkov resonance between the background plasma electrons and waves or collisionless Landau damping. The Alfven wave energy absorption in the dissipative layer can lead to the formation of electron fluxes (with electron energies of 2–5 eV) toward the ionosphere and initiate here the stable auroral red (SAR) arcs.

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ANTENNA PATTERN CALIBRATION USING AN UAV–BASED DEVICE

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ABSTRACT: In this article, ready-made antenna pattern calibration systems with measurement results are considered. The calibration of the antenna shows the real characteristics of the antenna. This article is a brief overview of this method.
KEY WORDS: radiation pattern, radiation pattern measurement, UAV, radiation pattern calibration.

Introduction

It is a well-known fact that the simulated radiation pattern (RP) of any antenna system differs in one way or another from the real one, depending on many factors such as the influence of surrounding objects, changes in the parameters of the radio wave propagation medium, non-ideal matching of the antenna with the feeder, the difference in the geometric parameters of a real antenna from the antenna model, the influence of the earth's surface, etc. For radio systems for which the RP parameters are important, they can be calibrated. Also, for large antenna systems that cannot be tested in a specialized anechoic chamber, it becomes possible to evaluate their RP.

With the advent of lightweight unmanned aerial vehicles (UAVs), quadcopters (hexacopter) capable of lifting special equipment and an antenna, their active use for antenna calibration began immediately. There are other ways to do this, such as using an airplane, helicopter, hot air balloon, but using a quadcopter is much cheaper, besides it can hover at a point in space to take multiple readings, etc.

Calibration systems

Two quasi-rectilinear flights of the UAV have been performed and autonomously tracked with the total station. The position data projected on the horizontal plane are shown in Figure 1. Both measurement and simulation of the received power at 150 MHz for the quasi-E-plane scan are reported in Figure 2 with the solid and dashed curves, respectively. Their comparison shows a very good agreement.

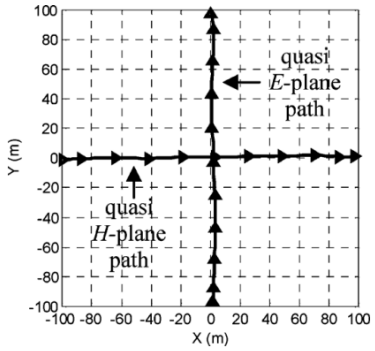

Figure. 1. Two UAV flights over the biconical antenna. The AUT is located in the center of the reference system.

The quasi-H-plane results for the biconical antenna are reported in Figure 3. The maximum deviation is about 1 dB at the two ends of the path. This value can be considered as an accuracy estimation of the proposed verification process.

The influence of the soil on the radiation pattern has been quantified in the order of 4 dB from the comparison between the dotted and dashed plots in Figures 2 and 3. This discrepancy highlights the importance of the AUT characterization in its real environment.

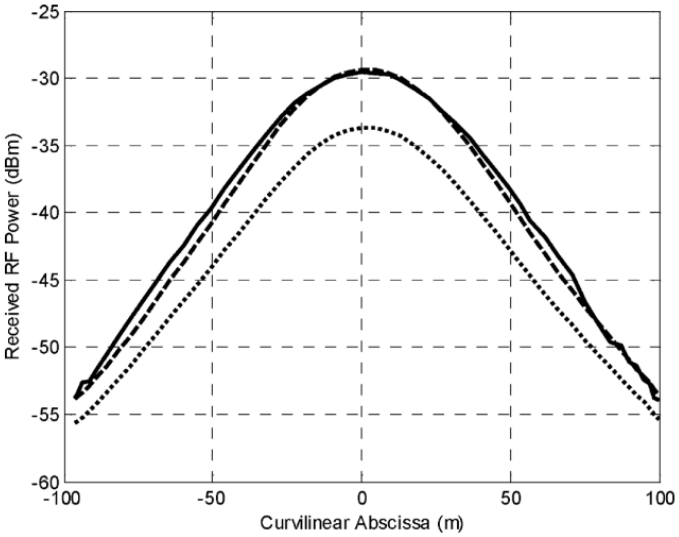

Figure 2. Received power pattern for quasi-E -plane scan of the biconical antenna at 150 MHz: measurement (solid); simulation with soil (dashed); simulation without soil (dotted).

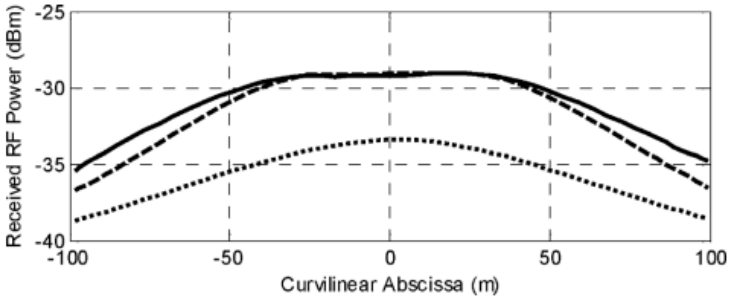

Figure 3. Received power pattern for quasi-H -plane scan of the biconical antenna at 150 MHz: measurement (solid); simulation with soil (dashed); simulation without soil (dotted).

The article also presents other calibration results.

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UDC 550.93

AMBIGUITY IN THE INTERPRETATION OF BADDELEITE DISCORDANT VALUES

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ABSTRACT: Review of the type of ^{235}U-^{207}Pb discordance in baddeleyite attributed to capture ^{231}Pa when this mineral crystallizes from uranium-poor mafic melts.
KEYWORDS: baddeleyite, ID-TIMS.

Baddeleyite is the most important and reliable U-Pb mineral geochronometer used to estimate the age of rocks, mainly mafic in composition. However, on diagrams with concordia, baddeleyite often shows a slight degree of discordance. The occurrence of discordance may be due to a number of factors – losses of radiogenic lead, recrystallization of baddeleyite into zircon at younger geological events, the presence of excess ^{207}Pb. Correct consideration of the cause of discordance can significantly affect the right assessment of age. The works [1-2] show that baddeleyite crystallized in carbonatite magmas captures a substantial portion of ^{231}Pa, which is an intermediate product of the ^{235}U-^{207}Pb chain, resulting in an excess of ^{207}Pb. Is such a discordance mechanism essential only for uranium-rich carbonatite magmas, or is it also important for uranium-poor mafic magmas? To answer the question, we consider the example of published data obtained from the baddeleyite of three mafic dikes of the North China craton [3].

In [3], according to the U-Pb dating of baddeleyite by the ID-TIMS method, the age of these dikes, estimated by the average values of $^{207}Pb/^{206}Pb$, is about 920 Ma (million years). As can be seen, all individual values for baddeleyite are discordant. In [3], it is assumed that discordance is caused by losses of radiogenic lead. Suppose that discordance is associated with the capture of ^{231}Pa during the crystallization of baddeleyite in magma, we calculate the age by applying such values $(^{231}Pa)/(^{235}U)$ so that the oldest grain of baddeleyite becomes concordant [4]. In this case, all three dikes show similar age values in the range of 909-912 Ma (Fig. 1). These recalculated values are younger than the published ones by about 10 million years. Which discordance model is correct – the loss of radiogenic lead or an excess of ^{207}Pb – cannot be determined from these data alone. However, in an earlier work [5], dikes related presumably to the same magmatic event were dated using an ion probe and age values of 899 ± 7 million years were obtained for them. We found that the values adjusted for ^{231}Pa-^{235}U in the baddeleyite (Fig. 1) are closer to the age values obtained from work [5]. Thus, it is shown that discordance associated with an excess of ^{207}Pb can be present both in baddeleyite crystallized from uranium-rich carbonatite and uranium-poor mafic magmas.

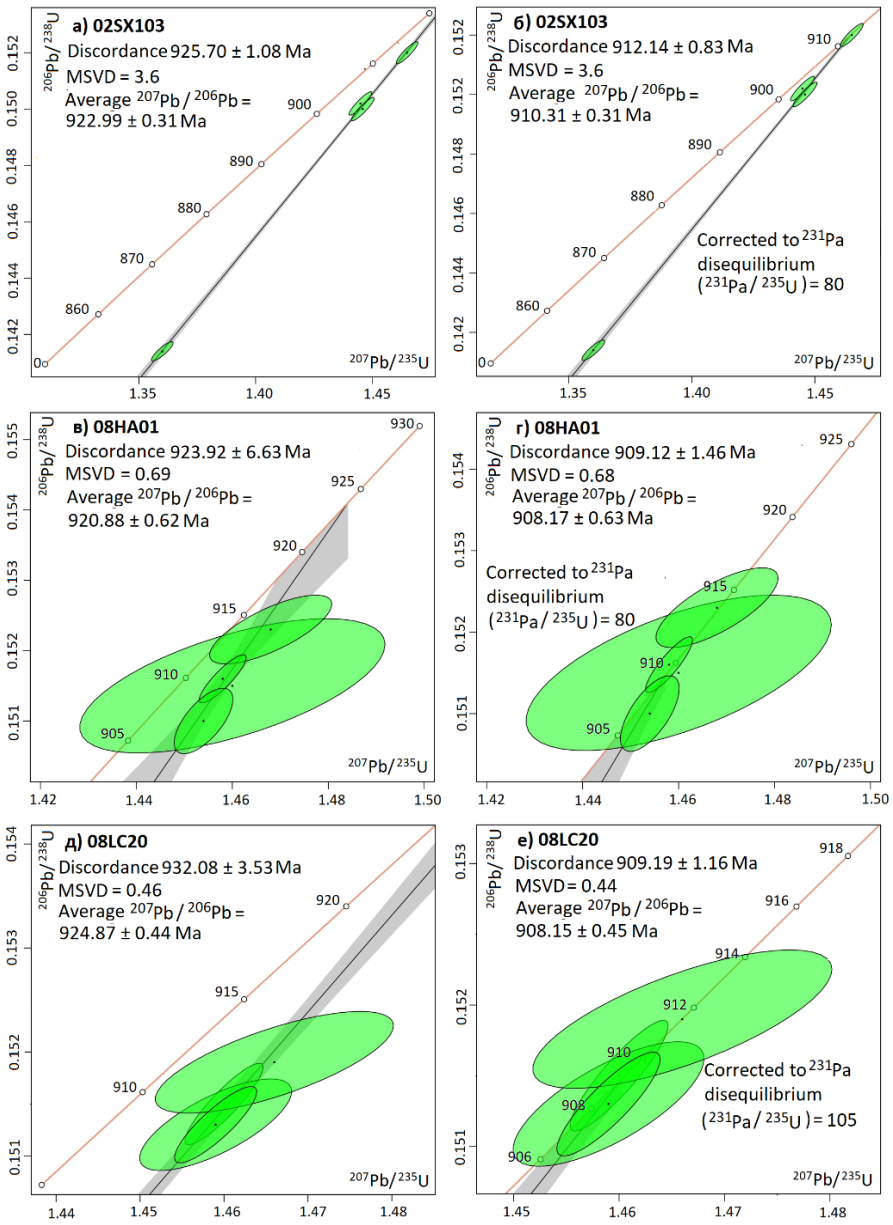

Figure 1. A diagram with concordia. The left diagrams are based on published data [3], the right ones are recalculated values taking into account the ^{231}Pa-^{235}U disequilibrium. The diagrams are made in IsoplotR [4]. Errors 1σ.

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ULTRA-SHORT-PERIOD GEOMAGNETIC FIELD PULSES

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ABSTRACT: We investigated the properties of pulse disturbances in the geomagnetic field, which are observed synchronously on the networks of induction magnetometers of the Institute of Solar-Terrestrial Physics (ISTP SB RAS) and the Canadian stations of the CARISMA project [1]. We showed that one of the sources of the studied disturbances may be red sprites; for this purpose, we used the results of the paper [2] on the spatial and temporal fixation of sprites in Northern China.

KEYWORDS: geomagnetic pulsations, magnetosphere, ULF-ELF frequency range, red sprites, lightning, Alfvén resonator.

In this work, we studied ultrashort-periodic pulses (USP) in the geomagnetic field, the main feature of which is their synchronous registration on a wide network of induction magnetometers: stations of the Institute of Solar-Terrestrial Physics (Istok, Mondy, and Uzur) and Canadian stations of the CARISMA project (Ministik Lake and Thief River Falls). The detected disturbances are short (T = 0.3-0.8 s on average, less frequently up to 2 s) synchronous pulse oscillations in the geomagnetic pulsation data.

We performed a morphological analysis of the studied disturbances (152 cases of USP were selected), which resulted in obtaining their statistical characteristics. The double amplitude of USP varies from units to hundreds of pT, and on average is about 20 pT. The frequency of occurrence of USP is 6-12 pulses per minute. Using spectral wavelet analysis, we have shown that the USP frequencies lie in the range from 4 to 30 Hz and their frequency maxima corresponds to the maxima of the Schumann resonance and its harmonics.

Source of USP generation

Given the high frequency of occurrence, the global scale of observation, and a high degree of synchronism in the appearance of USP, we put forward the assumption that the source of the pulses may be lightning discharges.

The frequency range of thunderstorm radiation mainly lies in the region of very and ultra-low frequencies. Therefore, we used data from the VLF/ELF receiver installed at Istok station. In which we detected disturbances at frequencies up to 300 Hz, which accompany all of our detected USP. Having studied in what frequency ranges different types of lightning discharges are emitted, we found that the radiation from red sprites, just lies in the range of frequencies, which we observe in the VLF receiver data (i.e. up to 300 Hz with a maximum at 40 Hz).

In order to test whether red sprites can be a source of the generation of USP, we used the article [2], which triangulated and recorded the time of occurrence of red sprites in North China in August 2017. Comparing the results with pulsation data from Istok, Mondy, and MSTK stations, we found that following each of the six red sprite observations analyzed in [2], we see USP at stations in our complex network. This can be seen in Fig. 1, where the dashed red lines show the moments of occurrence of red sprites.

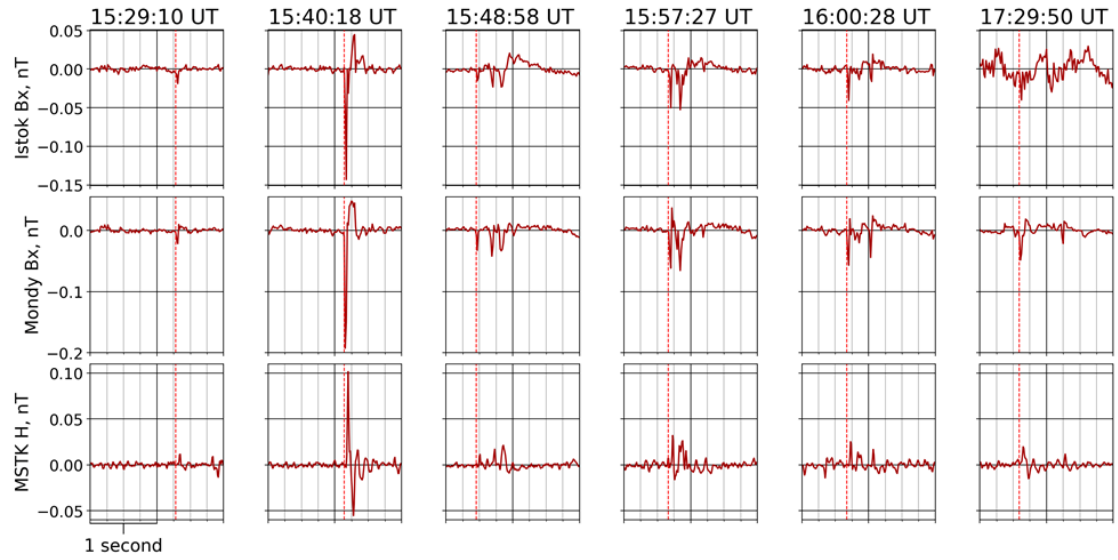

Figure 1. USP occuring at Istok, Mondy, and MSTK stations following the formation of sprites from observations in North China on August 8, 2017.

It can be noted that of the six electric sprite observation events, all six resulted in the appearance of USP. Unfortunately, we are unable to conduct a rigorous statistical analysis of the connection between the registration of sprites and the appearance of USP, due to the lack of additional data on sprite observations. We can conclude that it is very likely that all sprites cause the generation of USP, but we cannot say whether all USP have sprites as their source.

The study was supported by Grant No. 22-27-00280 of the Russian Science Foundation.

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UDC 528.8.04

INVESTIGATION OF VARIATIONS IN THE AEROSOL OPTICAL DEPTH BASED ON SATELLITE MEASUREMENT DATA

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ABSTRACT: Review of methods for studying the aerosol optical depth from satellite data

KEYWORDS: aerosol optical depth (AOD), remote sensing

Along with greenhouse gases and cloudiness, atmospheric aerosols play an essential role in radiation processes. Operational quantitative estimates of the aerosol optical depth (AOD) in the atmosphere, including the spatiotemporal distribution, are an important scientific and practical task [1]. The products of

satellite platforms with high spatial resolution are considered, which are of great interest, since they can be used to study local sources of aerosols in urban areas and monitor local air pollution. In particular, the analysis of Sentinel-2 products was carried out. The result of the work is a software and hardware complex for streaming data processing from Sentinel-2 satellites. Techniques for conducting research on a regional or global scale are described that use data with a global scope, such as data provided by instruments on board satellite platforms. In the final part, the temporal distribution of the aerosol optical depth (AOD) in space is considered.

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ULTRALOW FREQUENCY WAVES RESEARCH FROM CASE STUDY TO STATISTICAL ANALYSIS OF SPACECRAFT DATA

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ABSTRACT: Present paper describes key features of a case study and a statistical study of magnetospheric ultralow frequency waves using spacecraft measurements.

KEYWORDS: ULF waves, magnetosphere, data analysis, statistics.

Ultralow frequency (ULF) waves are magnetospheric phenomena related to energy transfer between different regions of the magnetosphere and from solar wind into the magnetosphere. ULF waves cover a frequency range from 1.6 mHz to 5 Hz. We pay special attention to the lowest frequency band (1.6–22 mHz) because this band corresponds to wavelengths comparable with the size of the Earth [1]. In the XXI century many satellites have been launched to investigate the terrestrial magnetosphere. Some spacecraft missions consist of one satellite while others include from 2 to 5 close spaced satellites. Each satellite is equipped with a number of instruments to measure electric and magnetic field vectors, and ion and electron fluxes in various energy ranges from units of eV to MeV. All spacecraft missions have huge teams for data post processing to provide high-quality scientific data for users. Initially, each observation of the ULF waves was a subject to study, when researchers were analyzing characteristics of a wave and wave-particle interactions in detail. As the time of observation and number of satellites increased, it became possible to conduct statistical studies and study the relation between external parameters and wave's behavior. In the present paper we describe features of a case study and a statistical study using modern spacecraft missions.

ULF waves are detected using magnetic or electric field measurements. Thus, it's always possible to find the dominant direction of oscillations — polarization of the wave. For case study, availability of plasma data becomes crucial. First, it gives an opportunity to calculate eigenfrequency from a theory, compare the result with observations, and understand a type of observed wave. For example, eigenfrequency calculation allows to reveal second harmonic oscillations when a fundamental mode is absent [2]. Second, waves resonate with ions or electrons at a specific energy that gives us information about the involved particle population and generation mechanism of the observed wave. In this case one may divide external excitation of a wave from internal instability [3]. Recent studies are using as much data as possible. It becomes normal to combine measurements from a number of satellites of different missions that operate in the same region. Often, it's the only opportunity to see a spatial scale of the disturbed region.

Statistical studies of ULF waves often use magnetic field measurements only. There are two main goals for such studies: to obtain spatial distribution of waves and reveal how solar wind and geomagnetic

activity affect wave excitation. First statistical studies found localized character of waves with different polarization and strong inequality in occurrence rate of transverse (Alfvén) and field-aligned (compressional) waves [4]. Alfven waves are much more sensitive to solar wind parameters, especially plasma pressure, while compressional waves found dependence on the intensity of substorms. Modern statistical studies focus on details such as statistical properties of multi-harmonic toroidal waves at high latitudes [5]. Multi-spacecraft statistical study seems promising to investigate latitude dependence of ULF waves and spatial scales of wave propagation.

Many papers describing both case studies and statistical analyses were published in recent years. This fact indicates that ULF wave research is rising with the launch of new spacecraft missions and we expect more discoveries in the short term.

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EXPERIMENTAL STUDY OF INTERNAL GRAVITY WAVES

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ABSTRACT: Review experimental study of internal gravity waves using DPS-4 ionosonde and incoherent scatter radar.

KEYWORDS: internal gravity waves, traveling ionospheric disturbances, ionosphere, upper atmosphere, experimental study

Processes in the upper atmosphere (UA), which is one of the main elements of the Sun-Earth system, are diverse in physical nature and have a multifactorial character. Due to the absorption and transformation of energy flows, they are the transfer of momentum that come from various sources: solar radiation, solar wind and magnetosphere, meteorological processes in the lower atmosphere, anthropogenic impacts. The UA dynamics is largely determined by the planetary and internal gravity waves (IGW) of its neutral component, which have a wide range of spatial (from units to thousands of km) and temporal (from several minutes to several days) scales. The sources of these waves are diverse – meteorological processes in the troposphere, Joule heating by ionospheric currents, terminator motion, explosions, earthquakes, etc. Therefore, these waves are constantly present in UA and form a complex multiscale dynamic pattern. The reaction of the ionosphere to IGW manifests itself in the form of traveling ionospheric disturbances (TIDs), which have been studied for many years[1].

With the use of data from vertical and oblique sounding stations, extensive experimental material was obtained on such characteristics of TIDs as quasi-periods, wavelengths, amplitudes of variations in the effective height h'F2 and critical frequency fOF2. The dependence of these characteristics on the level of solar and magnetic activity, season, local time for various regions of the Earth were studied. Various mechanisms of IGW generation and features of their propagation have been studied using appropriate models, and relationships between the characteristics of IGW and TID have been established. However, many questions remain relevant. The key ones are the identification of IGW sources, a quantitative description of the processes of energy transfer to the region of small scales, the mechanisms of wave-wave and wave-wind interactions, the effect of IGW on the development of ionospheric plasma instabilities and the generation of its irregularities. To study these issues, new research methods are needed that allow measuring the spatiotemporal structure of the complex TID field, and not just its individual characteristics. An analysis of such a structure is necessary for identifying and localizing IGW sources, separating disturbances by spectral composition and heights, studying their dynamics in space, and determining the parameters of IGW propagation and interaction.

This paper presents the method of experimental study of IGV through determination of the total TID velocity vector using data from the DPS-4 ionosonde and incoherent scatter radar.

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OPERATION OF THE NAVIGATION RECIEVER UNDER THE INFLUENCE OF INTERFERENCE

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ABSTRACT: An experimental study that shows the influence of GSM cells and radar on navigation receivers.

KEYWORDS: positioning, outdoor-navigation, navigation receivers.

The operation of navigation receivers is closely related to the impact of various interference sources occuring during the operation of radio equipment. The impact of interference has negative consequences on the quality of navigation equipment of satellite radio navigation systems users , up to a complete breakdown of radio navigation parameters measurements. The article presents the results of a study of the influence of interference created by telecommunications and communications on the actual availability of radio navigation parameters measurements based on signals from visible GPS and GLONASS navigation satellites. The paper analyzes the effect of radar equipment and cell towers on the operation of GPS/GLONASS signal receivers and examines the nature of the phenomenon of interference effects over time.

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FEATURES OF THE GEOLOGICAL STRUCTURE OF PRECAMBRIAN SEDIMENTARY FORMATION OF THE BAYKIT ANTECLISE

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ANNOTATION: This article presents the proof of the prospects of Precambrian sedimentary strata of the Baykit anteclise on the basis of available data on drilled wells and geological and geophysical data.

KEYWORDS: Baykit anteclise, precambrian sedimentary formation, Siberian Platform, Kuyumbinskoye field, Riphean carbonate sediments, Yurubcheno-Tokhomskoye oil and gas field, the Riphean deposits, Oskobinsky fault, Madrinskaya formation, Vadresh formation, Taiginskaya formation, Tokur formation, Zelendukon suite, Iremeken suite, Taimbinsky site.

The central areas of the Siberian Platform have huge predicted hydrocarbon resources [5, 8, 9]. According to the scheme of tectonic regionalization, the Baykit anteclise is one of the superorder structures of the southwestern part of the Siberian Platform [1, 3, 5, 9, et al.] (Fig. 1 Drilling of the parametric well Kuyumbinskaya-1 in 1973 resulted in the discovery of the gas deposit in the Riphean carbonate sediments, where commercial gas inflows were obtained.Thanks to this well, the Kuyumbinskoye field, unique in reserves, was discovered. However, subsequent drilling of 16 wells in the area did not yield commercial hydrocarbon inflows. Later, in 1982, as a result of drilling the Yurubchenskaya – 2 well, in the interval covering the Riphean's Oskobin suite, commercial inflows of gas and then oil were obtained, and the unique Yurubcheno-Tokhomskoye oil and gas field was discovered. [1, 3, 5, 7, 9 et al.].

Fig. 1 Fragment of the scheme of oil and gas potential of the Lena-Tunguska basin.
Fields: 5 - Kuyumbinskoye, 6 - Yurubcheno-Tokhomskoye, 8 - Sobinskoye, 9 - Paiginskoye.

In total, about 200 wells have been drilled in the central and western parts of the Baykit anteclise. At the same time, the eastern part of the Baikal anteclise has been studied poorly and unequally by drilling. All in all, only five parametric wells and six appraisal wells have been drilled.

The comparison of the section opened in the wells raises certain contradictions. Thus, on the available correlation schemes for the wells of Taiginskaya 1, Podporozhnaya 106, Kolymovskaya 139 and Nizhnemadashenskaya 138, the Riphean deposits are attributed both to the oldest (Madrinskaya and Vadresh formations [6]) and the youngest (Taiginskaya and Tokur formations [4]). There are differing opinions on

the belonging of the deposits of the Riphean strata uncovered by the wells of Podporozhnaya - 106 and Taimbinskaya – 102: some researchers attribute them to the Zelendukon suite, others - to the Iremeken suite. The correlated reflection horizons are justified by the dynamic features of the seismic record.

The main feature of the structure of the Riphean rocks is that it is broken up by a series of predominantly sublatitudinal faults [1, 2, 5, 9], which, perhaps, are echelon to the large regional Oskobinsky fault, traced in the eastern part of the Taimbinsky site according to a set of geological and geophysical data. It seems that in reality the Riphean complex of rocks is fragmented much more strongly than the available data suggested.

Thus, the difficult structure of the Riphean deposits of the Baikal anteclise and ambiguous definitions of the age of the Riphean deposits require a qualitatively new approach to their study. In this case, when studying such complex reservoirs, it is necessary to attract as much information as possible and use a more complete set of geological and geophysical data.

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STUDYING OF THE RELATIONSHIP BETWEEN MICROWAVE AND METER WAVELENGTH EMISSION FROM FLARE ON JUNE 3, 2021

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ABSTRACT: Review of relationship between microwave and meter wavelength emission.

KEYWORDS: solar flare, type III burst, X-Ray emission, microwaves emission, meter emission, accelerated electrons.

We present the preliminary results of the flare analysis. It took place on 3rd June 2021, at 01:36 UT. The event was observed by the E-Callisto spectrograph network and in microwaves by Siberian Radioheliograph (SRH) within the 3-6 GHz.

We found several Type III and Type-J bursts in the meter radio range. At the same time, only one burst was detected in the time profiles of microwaves emission and hard X-Ray (HXR) emission (GBM/FERMI). This one corresponds to the strongest type III radio burst. The spectral properties of microwaves and HXR emissions indicate the presence of accelerated electrons. The SRH images in the 2.8-5.6 GHz range showed two emission sources with different dynamics. Comparison of the SRH time profiles, obtained for two sources, allowed to find delays between microwaves and meter wavelengths in range 75-79 MHz.

A possible scenario of this event is discussed.

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Session 2. Linguistics and Educational Sciences

UDC 81

EMOTIONALLY COLORED STATEMENTS IN ARGUMENTATION

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ABSTRACT: The article considers emotionally colored statements and its function in the process of argumentation.
KEYWORDS: argumentation, emotionally colored statements, argumentative tasks.

Nowadays the efforts of scientists are focused on the communicative-pragmatic orientation of speech, taking into account all the circumstances of a particular communicative situation with all its structural components. [6]

In the paper of I.Y. Loginova, argumentation is understudied as a verbal, rational activity aimed at achieving acceptance by the audience of the point of view of the argumentator, and proceeding in a certain historical, social and cultural context [8, p. 240-248].

According to A.P. Alekseev, a view of argumentation as a type of activity naturally sets the scheme for considering it as an activity. [1, p. 18].

V.F. Asmus presents it as a reasoning consisting of a series of inferences proving the truth or falsity of the thesis [2, p. 348].

According to N.S. Barebina, "argumentation is an activity aimed at persuading the subject with the help of special reasoning" [3, p.13].

We, following G.M. Kostyushkina, except the following definition of argumentation: “argumentation is a verbal human activity in a specific social context” [6, p. 31].

The fact that any communication takes place “in an environment filled with human emotions and passions,” G.V. Kolshansky [5, p. 140], V.G. Gak [4, p.95] mentioned, as well as many other authors.

Let us use the verbatim reports of the Scientific Council of the Russian State Pedagogical University named after A.I. Herzen as examples:

(1) It involves changes, certain innovations and changes, nevertheless relies on exceptional value, involves the use of the university, the team, the people, the team, which inspires me and, I hope, in all our beliefs and hopes that the university is ours will be under your control the state to flourish. I am very happy and wish that we have these procedures of inauguration and delivery of traces of observation as rarely as possible (transcript of the meeting of the academic council dated January 25, 2018).

The thesis in this case is the desire of the author to change the rector as rarely as possible; the arguments are: "You were able to overcome the complex, you were able to build a job, the university will flourish under your leadership." Here we also observe emotionally colored statements with a positive connotation, emphasizing the warm relations between colleagues. Emotionally colored expressions ("glad", "succeeded", "prosper", etc.) in this case again perform the function of strengthening the argument. The conclusion is obvious - under the leadership of the rector the university will prosper.

(2) Almost this year, a little earlier, you celebrated 40 years of your professional academic activity. And I can say with pride that for a quarter of a century my activity in this academic field intersected with your activity, which gives me confidence in the correct understanding of the tasks that are set in different departments of our faculty (transcript of the Academic Council meeting dated January 25, 2018)

The thesis in this case is to express the joy of working with the rector, the argument is "this gives me confidence in the correct understanding of the tasks." In this statement, the speaker convinces us that for a long time he liked working in this team, and emotionally colored expressions reinforce this argument. The conclusion can also be drawn about the correctness of the tasks set at the faculty.

Thus, we come to the conclusion that emotionally colored statements do play an important role in argumentation, and this role is not so far from the role of the so-called logical arguments and premises. But at the same time, emotionally colored statements are not a direct argumentation, but an enhancement of the argumentation that already exists in the text. The power of emotionally colored statements, therefore, only affects the argumentative potential of the statement. This means that emotionally colored statements don't have a direct function of argumentation, they perform an auxiliary function of strengthening argumentation.

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UDC 81

LINGUISTIC ACADEMIC LANDSCAPE: STRUCTURE AND DYNAMICS OF RENEWAL

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ABSTRACT: The paper presents preliminary results of the analysis of the linguistic landscape of the Institute of Earth Crust SB RAS.

KEYWORDS: linguistic landscape, linguistic properties, announcements.

Investigations of the linguistic landscape vary in design and methods. The present work is based on a quantitative approach aimed to determine the degree of presence of different types of announcements in the public space of a scientific institute. The method makes it possible to perform representative sampling of the linguistic landscape of the scientific institute, identify units of analysis and conduct their reliable statistical analysis [Alòs i Font, 2016, p. 99]. According to the research of P. Backhaus [Backhaus, 2007, pp. 61-62] and E. Alòs i Font [Alòs i Font, 2016, p. 100], the primary tasks of the studying of linguistic landscape are to determine the survey area, to identify the survey items and to describe their linguistic properties. This paper summarizes the approach to solving the first two problems. The object of the study was the information stands of the hall of the administrative building of the Institute of the Earth's Crust SB RAS (Irkutsk).

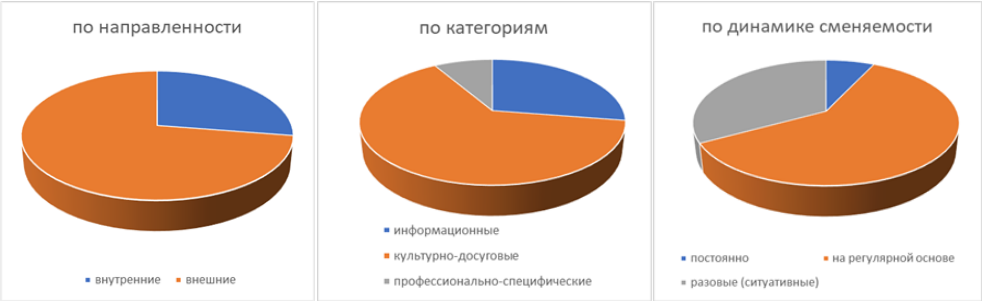
Until the end of the 2010s, a false wall was used in the lobby of the Institute for placing announcements attached with buttons and pins. The central part of the wall was allocated for current information units with regular renewal, while the lateral parts, as a rule, were occupied by external informational, cultural and leisure ads, often outdated.

Professional-specific announcements on the multimedia screen deserve special mention: the screen shows up-to-date online maps of the latest earthquakes in the Irkutsk region thanks to direct communication with the server of the Baikal branch of the FRC of the GS RAS.

After the demolition of the false wall in 2019, two permanent metal stands were installed in the institute lobby, the surface area for announcements decreased by about 5 times. The frequency of their renewal has increased, as the administration of the Institute has taken a course for updating, giving preference to informational and professionally-specific announcements. However, at the moment cultural and leisure ads occupy more than half of the information on the stands (64%).

In this paper, the unit of research is an announcement of any type in the form of a written text in the space of an information stand. We classified the information according to the designated research units (ads, 58 units) according to the following parameters:

1. by origin: external – 42 (72.5%), internal – 16 (27.5%);
2. by category: informational – 16 (27.5%), cultural and leisure – 37 (64%), professional-specific – 5 (8.5%);
3. according to renewal dynamics: indefinite – 4 (7%), on a regular basis – 35 (60%), one–time (situational) - 19 (33%).



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UDC 81-11

LINGUOCOGNITIVE FEATURES OF THE USE OF METONYMY IN RUSSIAN INTERNET DISCOURSE

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ABSTRACT: The article is devoted to the peculiarities of the functioning of metonymic transfer within the framework of the Russian Internet discourse. The paper considers the cognitive mechanism of the implementation of metonymic transfer within the framework of the Russian Internet discourse.
KEYWORDS: linguistics, cognitive pattern, metapragmatic awareness, metonymy.

The logic of metonymic transfer is due to the hypertextual nature of Internet discourse.The hypertextual nature of the Internet discourse is determined by the environment of its existence. A characteristic feature of the texts that make up the nature of Internet discourse lies in the fact that such texts go beyond the framework of a single text structure. Thus, the text turns into a dynamic system, not limited by scope and genre, connected with other similar systems. In this regard, within the framework of the hypertextual nature of the Internet discourse, the logic of the use of metonymic transfer by the participants in the communicative process implies the implementation of this transfer within the cognitive field of the precedent text, which reflects the value picture of the world of the communication participants.

Metonymic transfer is a cognitive mechanism for correlating language with reality.

In the context of research conducted by modern linguocognitive science, we can argue that metonymic transfer is a complex mechanism for correlating a language with the reality reflected in it. Accordingly, in relation to a participant in the communicative process using metonymic transfer, the cognitive mechanism of such transfer implies extrapolation of the author's conceptual vision of objects of reality, their correlation and interrelation.

The logic of metonymic transfer is based on the cognitive patterns of communication participants.

First of all, among the cognitive structures that influence the logic of metonymic transfer, we should note the “starting point” of such an action, which can be such a complex structure as a cognitive pattern. Within

the framework of our study, the most successful is the definition of a cognitive pattern as a set of basic intuitive representations. Accordingly, we can assume that in the process of communicative interaction, the participants in this process, using metonymic transfer regarding the same object, will demonstrate different ways of its implementation due to the fact that its logic will be based on different cognitive patterns.

The logic of the implementation of metonymic transfer is due to the metapragmatic awareness of the participants in the communicative process.

Metapragmatic awareness of communication participants is an intuitive understanding of the context of communication by its participants, which determines the logic of using speech means in accordance with the context. Jef Verschueren highlights two key aspects of this phenomenon [1]. Firstly, this is the correlation of the speech means used with the context of their use, and secondly, the linguistic reflection of the participants in communication in the process of interpreting its context. In relation to the issue we are considering in this article, it seems that the implementation of metonymic transfer will be determined by the context of its application, based on the metapragmatic awareness of the communication participant within his cognitive pattern.

Metonymic transfer, being a cognitive mechanism for correlating language with reality, performs the function of discourse attribution within the framework of the communicative process.

Thus, the above cognitive mechanisms allow metonymic transfer to realize its connotational function within the framework of the multi-institutional environment of network discourse. So, being a kind of semantic-derivative connotation, metonymic transfer performs the functions of discourse attribution, within which there are cognitive patterns of participants in the communication process, formed by the linguocultural environment in which they exist.

The most striking feature of Internet discourse as a multi-institutional phenomenon is the verbalization of the linguo-cultural substratum of communication participants. Based on the foregoing, we can assume that the specificity of any national Internet discourse will primarily consist in the verbalization of the linguocultural substrate of their culture, which, in particular, will be reflected in the logic of constructing metonymic transfer, which will appeal primarily to precedent texts that are significant for a given culture, the interpretation of the texts of other cultures will be carried out through the prism of the «maternal» linguocultural substratum of the communication participant.

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USING ONLINE EDUCATIONAL RESOURCES IN FORMING AUDITIVE COMPETENCE OF FOREIGN STUDENTS

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ABSTRACT: The article defines the foreign language auditive competence, its indicators and components, emphasizes the importance of its formation and highlights advantages of using online educational resources in the process.

KEYWORDS: foreign language auditive competence, indicators of auditive competence, components of auditive competence, online educational resources.

Foreign language auditive competence can be defined as a complex integrative characteristic of a listener, which characterizes its willingness and ability to carry auditive activity in foreign language corresponding to

such quantitative and qualitative parameters as the success and effectiveness, appropriateness and flexibility, speed and ease (easiness) of perception.

Regarding receptive types of activity, scientists have determined such characteristics of the listening result as completeness, accuracy and depth of understanding achieved during listening, as well as the amount of information extracted from what was heard.

The indicators of possession of the kind of speech activities also include a sufficient pace of perception and information processing, flexibility, as well as the perfection of listening skills.

The formation of competencies in receptive types of speech activity, and in listening in particular, should reflect criteria such as success, effectiveness and adequacy.

Success is the most general indicator and is designed to characterize the effectiveness of auditive activities, i.e. the recipient achieves his goal of listening, the realization of his own communicative intention, the achievement of the task.

Efficiency presupposes the flow of the processes of perception, understanding and interpretation without disturbances and failures, as well as without much effort on the part of the recipient. This indicator is the result of the interaction of a number of qualitative and quantitative characteristics (speed of perception, development of psychological mechanisms of listening, mastery of intellectual operations, etc.) and manifests itself in the ease (easiness), naturalness of the processes of listening to speech. Adequacy is a requirement for both the listening process and its result. It includes the ability to listen adequately to the goals and conditions of perception and presupposes the ability to manage listening processes and modify them from the point of view of the greatest appropriateness.

This indicator is directly related to flexibility, which assumes possession of various ways of carrying out activities (that is, different types of listening) and the ability to choose the most effective and economical in each case, as well as flexibly "switch" from one type of listening to another depending on changing conditions, changes of communicative intentions, etc.

These indicators are mutually dependent and presuppose a high level of development of auditive skills, abilities and intellectual operations, as well as the availability of relevant knowledge to ensure the implementation of auditive activity in a variety of communicative situations, in the course of mastering knowledge, developing skills, abilities and competencies [2].

Listening is one of the most difficult types of speech activity: as a rule, in real communication (especially academic communication), it is characterized by a one-time presentation; usually a listener (for example, a student, listening a lecture) has no opportunity to change anything, cannot adapt the sounding speech to his (her) own level of understanding [1].

There are a number of objective difficulties that impede understanding of sounding speech: difficulties determined by the conditions of listening; difficulties due to the individual characteristics of the source of speech; difficulties due to the linguistic characteristics of the perceived material.

Components of auditive competence:

- psychophysiological mechanisms (speech-motor, speech stream segmentation, probabilistic forecasting);
- auditive skills (listening, lexical, grammatical);
- auditive abilities (the ability to predict the content of a message, relying on knowledge of genre, structural and linguistic features, information sources; solve the communicative task of a message based on the situation; understand and interpret the information).

For overcoming noted difficulties and forming noted mechanisms, skills and abilities we (teachers) should provide our students with a sufficient number of tasks and exercises. One of the most convenient and effective ways of doing it is using online educational resources, for example, creating electronic courses in Moodle.

Advantages of using online educational resources:

- time and territorial independence;
- objective assessment of results;
- variativity;
- flexibility;
- individual learning trajectory (path);

- psychological comfort.

Exploring the modern features of the process of teaching foreigners, we should better take into account that the external circumstances (like distance learning) “can be an obstacle to successful perceiving both non-native culture and the acquired language” [3].

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FORMATION OF INTERCULTURAL COMPETENCE OF FOREIGN STUDENTS: STATEMENT OF THE PROBLEM

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ANNOTATION: Intercultural communication has provoked the necessity to create a personality with a new set of qualities and competences, which are necessary for rational functioning in the contemporary world.

KEYWORDS: communicative behavior, intercultural competence

Students learning Russian as a foreign language need special pedagogical and psychological assistance in overcoming difficulties. Intercultural communication has provoked the necessity to create a personality with a new set of competences. In this regard, the development of intercultural scientific competence of students becomes relevant, which is due to the requirements put forward today to the specialists in different fields.

Students learning Russian as a foreign language need special pedagogical and psychological assistance in overcoming difficulties and different barriers arising in the process of language and culture learning [2], as professional training in higher education institutions of the Russian Federation has serious differences from the education system in their home country. The most difficult for a bilingual (as the final stage of a language acquisition) in terms of mastery and adaptation are the components of the new culture, which are associated with the language system and with the pragmatic attitudes of an individual [3], the process of their professional development largely depends not only on the knowledge of Russian, but also on the presence of the necessary knowledge of the host country, native speakers, mentality, cultural differences and

specific communicative nature of behavior, that is, it directly depends on the level of intercultural competence formation.

The relevance of the research is conditioned by the constant development of modern society. As a result of which intercultural communication and global transformations taking place in the world have provoked the necessity to create a personality with a new set of qualities and competences, which are urgently necessary for rational functioning in the contemporary world. The ongoing development of print media provides new opportunities for learning foreign languages, including Russian as a foreign language.

This knowledge will help you to keep abreast of the latest developments in the world, to participate in international conferences and to work in transnational teams. In this context, the relevance of professionally oriented language education increases. It is equally important not only to know a particular language, to understand spoken and written speech, to express your thoughts, but also to be able to establish contact with bearers of a different culture, to achieve mutual understanding with foreign colleagues working in the same field but representing a different society and culture. This can be helped by mastering intercultural communication skills and being able to successfully apply them in practice.

In this regard, the development of intercultural scientific competence of students becomes relevant, which is due to the requirements put forward today to the specialists in different fields.

The analysis of scientific literature [1] shows that the problem of intercultural competence is actively studied by scientists all over the world. This can serve as a proof that the research topic is relevant and important for the theory and methodology of teaching foreign languages, including Russian as a foreign language.

Speaking about the degree of scientific development of the problem, it is necessary, first of all, to pay attention to the interdisciplinary nature of such a concept as "intercultural competence" which requires addressing a wide range of publications in different fields: philosophy, culturology, sociology, pedagogy and even psychology. Studying this problem through the prism of all the above-mentioned aspects will help us to reveal the concept of "intercultural competence", its essence and formation mechanism.

Intercultural competence is considered mainly in the theory and practice of language education, leaving other psychological and pedagogical aspects without due attention.

However, the majority of theses and dissertations and scientific articles do not consider the whole range of problems. In particular, we noted insufficient research on the problem of forming intercultural scientific competence through the use of journal articles in teaching Russian as a foreign language, which definitely have their own features in learning the culture of the studied language. Furthermore, there is extensive commonality across these models, which provides strong conceptual paths along which future theory development can and should progress.

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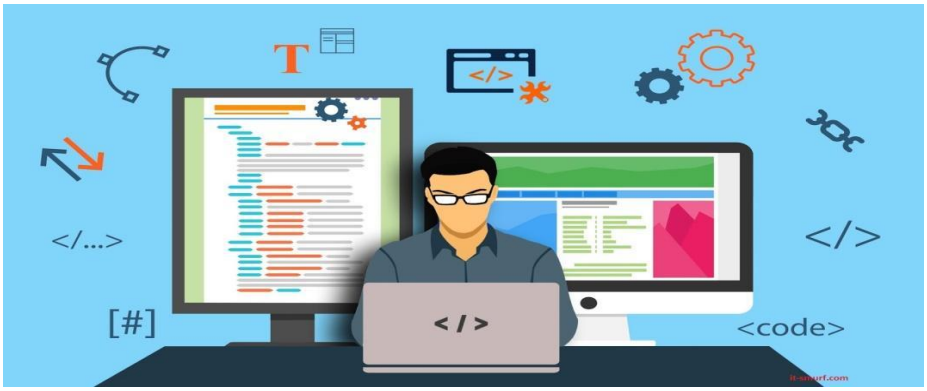

Session 3. IT, Engineering, Digital Science

UDC 621.3.07

ANALYSIS OF WAYS TO INCREASE THE FLEXIBILITY OF THE ENERGY SYSTEM WITH A HIGH SHARE OF WIND POWER PLANT ENERGY DURING TRANSIENT PROCESSES

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ABSTRACT: A description of electric power system flexibility in the form of a dynamic model based on an inhomogeneous Euler differential equation.

KEYWORDS: dynamic simulation, electric power system, flexibility, transients.

Electric power systems of the 21st century are undergoing radical changes in their internal structure and properties, this transition is characterized by the emergence of new challenges in the organization of parallel operation in the electric power system of stochastic generation sources (wind and solar), that at a sharp change can significantly affect the stability of electric power system (EPS), which significantly reduces its ability to self-adapt and self-stabilization and, consequently, reduces its flexibility level.

To describe quantitatively the flexibility of the electric power system, a generalizing coefficient $\Im(t)$ is introduced. Flexibility in all elements of power systems is achieved by providing the following classifications of means of ensuring flexibility by levels of functioning of the EPS:

1. generation: power plants that can quickly and efficiently increase and decrease capacity;
2. electric power transmission: electric networks with low capacity have low static and dynamic stability margin;
3. means of management of electric power consumption demand: incorporation of smart grids to provide response of current consumption of electric power, its storage, operational management of generation;
4. control systems: technical means, which allow to obtain the property of flexibility from the existing network topology, for example, self-adaptation under various perturbations associated with the operation of RES.

In the paper an attempt to describe quantitatively the flexibility criterion is considered. Figure 1 proposes a vector block diagram of the formalization of the criteria and means of ensuring flexibility with the principle of impact by active and reactive powers in the EPS.

To describe the dynamics of the flexibility of the electric power system, which consists of a wind turbine and flexibility means, the inhomogeneous Euler differential equations of the second order [1-5], taking into account the damping of oscillations and resistances of flexibility changes in the form, can be used:

$$f(t) = \frac{d^2\Im(t)}{dt^2} + 2\beta\omega_0 \frac{d\Im(t)}{dt} + \omega_0^2\Im(t), \tag{1}$$

where *f(t)* is the function of the reference action on the oscillating system; *ω0* is the angular frequency of oscillations of the load; *β* is the damping coefficient of the system; *ℑ(t)* is the generalizing flexibility factor.

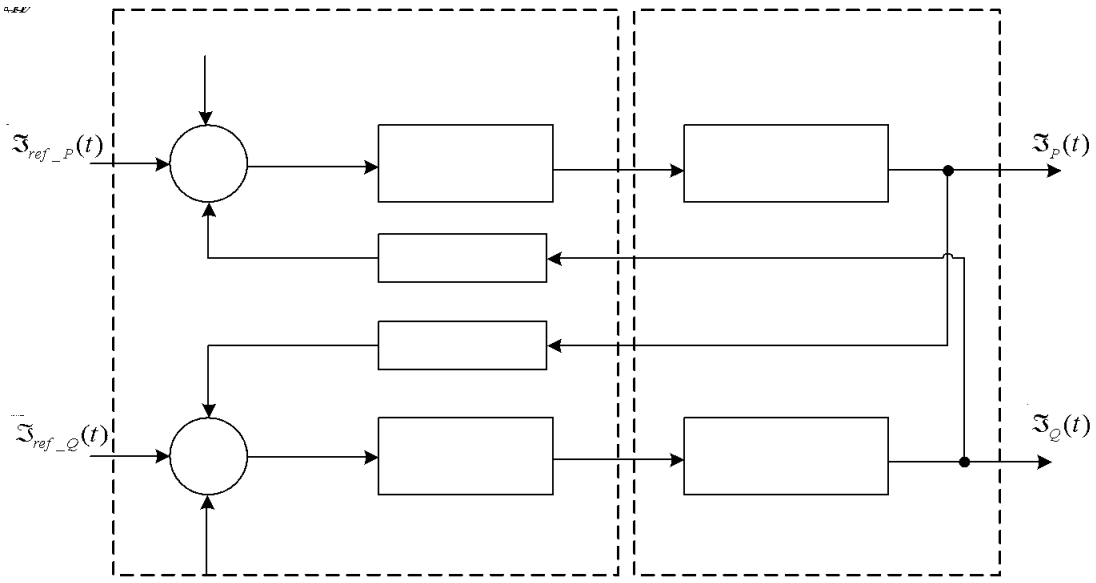

Figure 1. Block diagram of the dynamic model of EPS and the means to ensure its flexibility

The dynamic development of the electric power industry contributes to the formalization of new properties of electric power systems. The paper formalizes the concept of flexibility of the electric power system under the mutual influence of different network mode parameters. The availability of flexibility means was formulated according to the principle of echelon (subordinated) regulation, which allows estimating the factors of system performance under their mutual influence. Vector dynamic formalization of flexibility and its criteria, which allows evaluating the reserve of flexibility in EPS, was presented. The next stage of research will be connected with verification of the obtained mathematical models in order to apply them to the existing RES in Russia and to form normative parameters of quantitative assessment of EES flexibility criteria.

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UDC 621.311

BASIC INFORMATION ABOUT COMMERCIAL AND INDUSTRIAL MICROGRIDS

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ABSTRACT: In order to optimize the management process of the Unified Energy System of Russia (RAO UES) in 2020, the Government of the Russian Federation adopted Resolution No. 320 [1], which served as the beginning of a pilot project for the creation of commercial and industrial microgrids.

KEYWORDS: commercial and industrial microgrid, active consumer, renewable energy sources.

A commercial and industrial microgrid is a microgrid that has its own generation (power plants using various types of energy), an electric grid complex and a commercial consumer, interconnected by a software and hardware complex of a controlled intelligent connection. [2,3].

Commercial consumers get the opportunity to pay for electricity, as well as other services provided by the UES of Russia – continuity of power supply, maintenance of regulatory levels of frequency and voltage, and others – in predetermined volumes. At the same time, the fulfillment of mutual obligations of the parties within the framework of the functioning of the industrial microgrid will be provided automatically by modern digital technical means. In addition, the introduction of the new model will increase the efficiency of the UES of Russia by reducing the cost of creating, and in some cases maintaining, reserves of the network infrastructure exceeding the maximum volumes of electricity consumption from the power system accepted by the industrial microgrid [4].

The purpose of this article is to present basic information about commercial and industrial microgrids and brief characteristics of subjects that can be combined into commercial and industrial microgrids, and to create a flowchart of an advisor system to find the optimal cost-effective solution for managing industrial microgrids.

To find the optimal cost-effective solution for industrial microgrid management, it is proposed to create an advisor system, the purpose of which is to study possible microgrid management strategies and to choose the most effective strategy for a given period of time.

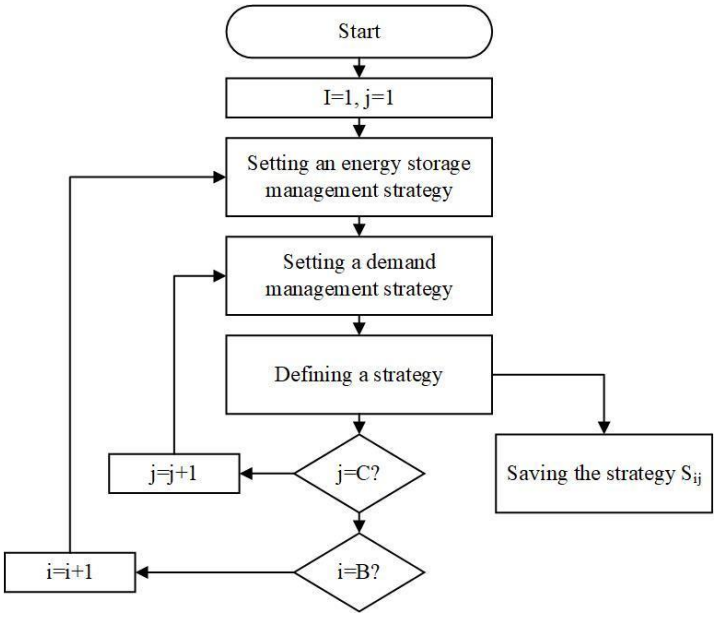

Figure 1. Flowchart of the adviser system

Figure 1 shows a block diagram of an advisor system for choosing the optimal microgrid management, in which there are active consumers, a wind power plant and a storage battery. Active consumers control their own daily load schedules, distributing peak loads for a period with minimal energy consumption. Electricity supply to consumers occurs in two ways: the use of its own generating capacity or, if there is a lack of it, the use of power from the network. Sources of own generation can be small thermal power plants and hydroelectric power plants, diesel power plants or power plants using renewable energy sources.

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UDC 004.8:620.9

APPLICATION OF COGNITIVE MODELING IN PREDICTIVE STUDIES OF THE FUEL AND ENERGY COMPLEX ON THE EXAMPLE OF SOFTWARE PACKAGE «INTEC-A»

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ABSTRACT: ESI SB RAS is actively conducting research into the energy security of the country and regions. For these studies, energy experts built an economic and mathematical model to study the development of the fuel and energy complex from the standpoint of energy security. The main difficulty in conducting such studies lies in their multivariate nature. To overcome this difficulty, the MESI SB RAS proposed a two-level technology for studying energy security problems, at the upper (first) level of which the stage of qualitative analysis (express analysis) is performed using methods and tools of semantic (ontological, cognitive and event) modeling, and at the lower (second) – quantitative analysis based on numerical calculations using traditional software systems. Also, the MESI SB RAS designed and developed an intelligent IT environment that supports a two-level research technology and includes semantic modeling tools and the software package «INTEC». Currently, the transition from semantic models to SP is carried out manually, the authors proposed to automate this process using the example of the INTEC-A version of the SP.

KEYWORDS: artificial intelligence, cognitive modeling, intelligent information technologies, mathematical and semantic modeling, IT-environment, multi-agent systems.

The MESI SB RAS actively conducts predictive studies of the fuel and energy complex from the standpoint of energy security [1]. To conduct these studies, a model of the fuel and energy complex was developed that describes the production, storage, transport and consumption of fuel and energy resources (FER) by region [2].

Forecast studies of the fuel and energy complex are of a multivariate nature, and the multivariance increases significantly due to the need to take into account the requirements of energy security: scenarios of possible emergency situations (ES), as well as operational and liquidation measures are superimposed on the basic options [3]. To automate this study, the software package (SP) «INTEC» was developed and reengineered.

The new version of the «INTEC-A» software is focused on solving large-scale optimization problems for energy applications using linear programming methods and is designed to automate data processing, research and calculations in modeling and optimizing the development of energy systems.

The scope of application of the «INTEC-A» software is limited to a range of tasks, the solution of which is based on the construction of production economic and mathematical models that describe the technological and territorial connections of the simulated systems. The methods of describing the connections and properties of the simulated systems in the mathematical model are determined by the features of the linear programming methods used.

The agent-service approach was used to develop the software package [4]. The multi-agent architecture of SP «INTEC-A» was developed. The master agent is the script generation agent. This agent acts as a coordinating agent. With its help, energy experts can set various situations and form individual scenarios. The agent is also needed to form dictionaries consisting of “code (TRV): decryption” pairs. Dictionaries are used to display the variables and constraints of models in natural language.

The agent for generating information models and making adjustments is necessary for convenient work with information models. This agent includes the ability to create new models through the use of a graphical user interface. Models and scenarios are transferred to the agent-computer.

Agent-solver – in the agent core is a library for solving a linear programming problem. The purpose of the agent is to search for the optimal values of the model variables.

The Calculation Visualization Agent is responsible for rendering the calculations. The main task of this agent is to build various tabular reports containing indicators of the results of a computational experiment that are of interest to the researcher.

The next stage in the development of SP «INTEC-A» is the integration of mathematical and semantic models. For this, it is proposed to develop an agent – an interpreter of cognitive maps, which makes it possible to edit fragments of the fuel and energy complex model, presented in the form of cognitive maps, and the ability to edit the characteristics of a cognitive map.

The application of cognitive modeling to the problem of energy security makes it possible to form scenarios for sustainable development and crisis development of the energy sector in the region, to identify

factors influencing scenarios for the development of the energy system, and to develop plans to counter threats to energy security using cognitive maps.

The integration of cognitive modeling into the new version of the «INTEC-A» software will provide the following features: visualization of calculation results using cognitive models; reducing the burden on experts by limiting calculation options; interface for working with the predictive research model of the fuel and energy complex; identification of implicit links, explicitly, and their formalization. It is proposed to integrate the support of cognitive modeling of the SP «INTEC-A», to provide the possibility of forming and correcting the computational scenario.

Acknowledgements. The reported study was funded by Russian Science Foundation, according to the research project No. 22-21-00841, https://rscf.ru/project/22-21-00841/.

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UDC 339.9

ECONOMIC ASPECTS OF PROTECTIONISM POLICY IN WORLD TRADE

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ABSTRACT: Review and analysis of forms, tools and methods of application of protectionism from the point of view of economic theory.

KEYWORDS: world trade, protectionism, free trading, foreign economic policy.

Protectionism in its essence is nothing more than a form of state intervention in the economy. And disputes about the expediency of state intervention in the economy have been going on for centuries. In essence, this is because the expediency of using this policy is constantly changing depending on the global economic trends of each individual time period. [1]

Despite the strong fluctuations in global trends in the past from the doctrine of free trade to the doctrine of protectionism, now at the current level of development of international economic relations, states mainly seek to pursue policies that combine both protectionism and free trade. The proportion in which they do this depends on the specific situation on world markets and in the country's economy.

However, empirical signals alone are not enough to choose one or another form of foreign economic policy. These issues have been an object of economic theory for decades. Theory today is the main tool used by States to optimize their measures in the field of foreign trade.

Theories of internal effects of foreign trade policy – explain the consequences for the national economies of countries of actions taken by the state in the field of foreign trade.

If we consider the theories of external effects of foreign trade policy, we can say that they already aim to explain what consequences the macroeconomic decisions of partners in the international arena lead to for each other.

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UDC 339

THE IMPACT OF THE FOURTH INDUSTRIAL REVOLUTION ON THE WORLD MARKET OF GOODS AND SERVICES

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ABSTRACT: The study of the theoretical foundations of the Fourth Industrial Revolution and the main components of industrialization. Analysis of the impact of "Industry 4.0" on the global market of goods and services and a review of statistical data.

KEYWORDS: the Fourth Industrial Revolution, world market, goods, services, economy, technologies.

As a result of the perfect storm of technology, the Fourth Industrial Revolution is paving the way for transformational changes in the global market. The purpose of the study is to define the concept of "Industry 4.0" and analyze the changes that have occurred within the scope of the global economy.

The Fourth Industrial Revolution marked the beginning of a digital economy driven by intelligent systems in real time. "Industry 4.0" describes the current trend of automation and data exchange thanks to the latest innovative components that are used in both the manufacturing and retail sectors.

It is expected that the advanced technologies of the Fourth Industrial Revolution, including the Internet of Things, blockchain, Big Data, robotics and other technological innovations, will lead to profound transformations in the global chains of the world market of goods, which indicates continuous improvements in some economic indicators (Figure 1) [1].

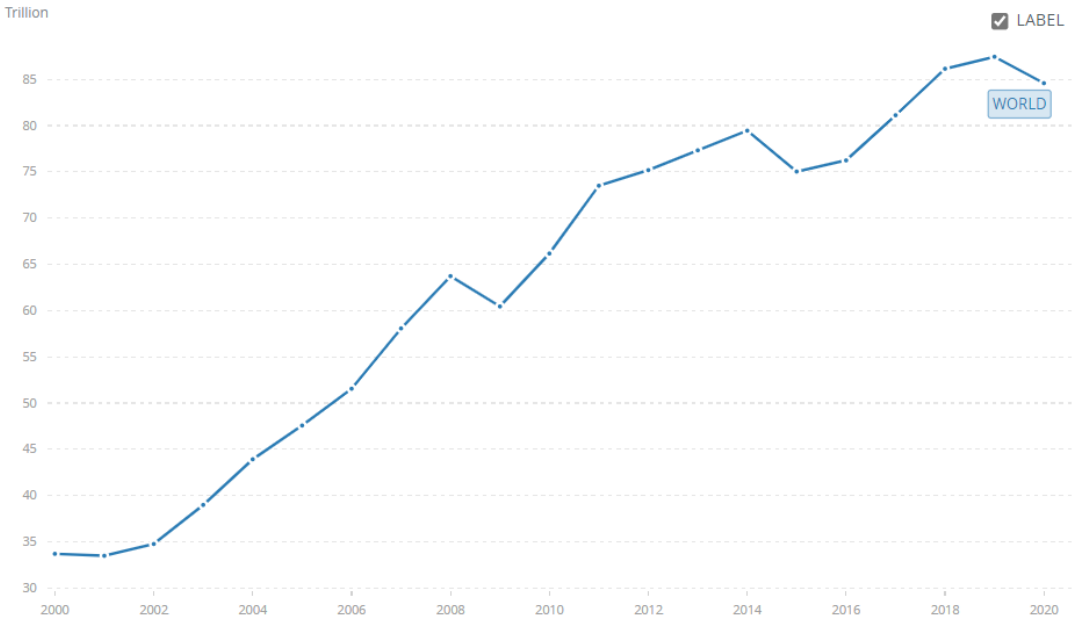

Figure 1. Global GDP, trillion US dollars

New technologies have changed consumer habits. Due to the rapid spread of the Internet, e-retail commerce is developing dynamically, and, first of all, marketplaces are rapidly gaining popularity (Figure 2) [2].

Figure 2. Global retail sales in the field of e-commerce, trillion US dollars

Services, with their growing importance in the global economy along with production, are becoming increasingly important for the economic growth of many countries [3]. The world is undergoing a radical shift, and the share of GDP attributable to services is increasing sharply in almost all countries of the world (Figure 3) [4].

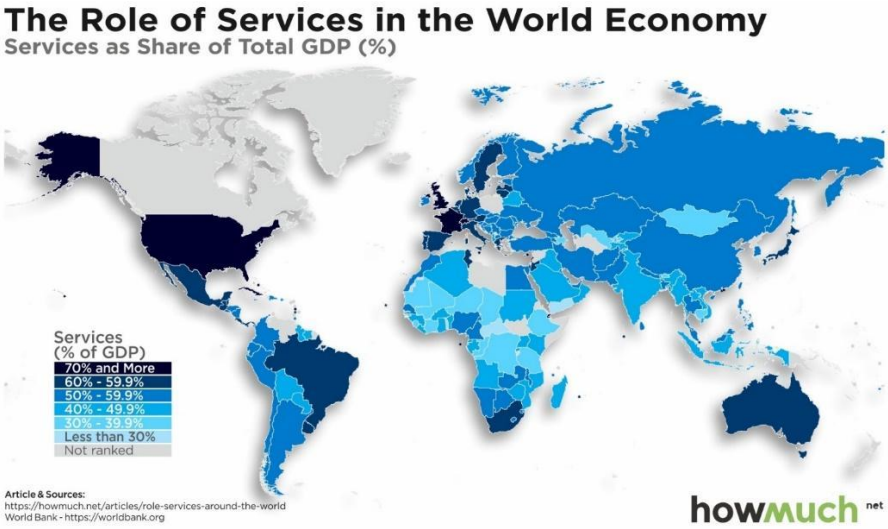

Figure 3. The role of services in the global economy. Services as a share of total GDP, %

In the final part, brief conclusions of the study are presented, as well as the most prospective sectors of the world economy and means of carrying out trade operations that will be relevant in the near future are identified.

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UDC 33.056

ANALYSIS OF THE STATE AND DYNAMICS OF THE GLOBAL SVOD-PLATFORMS MARKET

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ABSTRACT: Overview of the global market for streaming platforms, and analysis of the national markets of SVoD-platforms in the USA and China.

KEYWORDS: global market, streaming broadcasting, content, SVoD-platforms.

In today's digital space, streaming video has become one of the primary means of accessing information and entertainment content. Moreover, according to a recent study [1] 86% of customers are willing to pay more for a unique experience. The data presented suggests that while the total number of subscribers and revenues have increased globally, the growth trend for the former is showing a decline (Figure 1). The author attributes this decline to the fact that having a subscription to streaming platforms is a privilege that is more common among residents of developed countries.

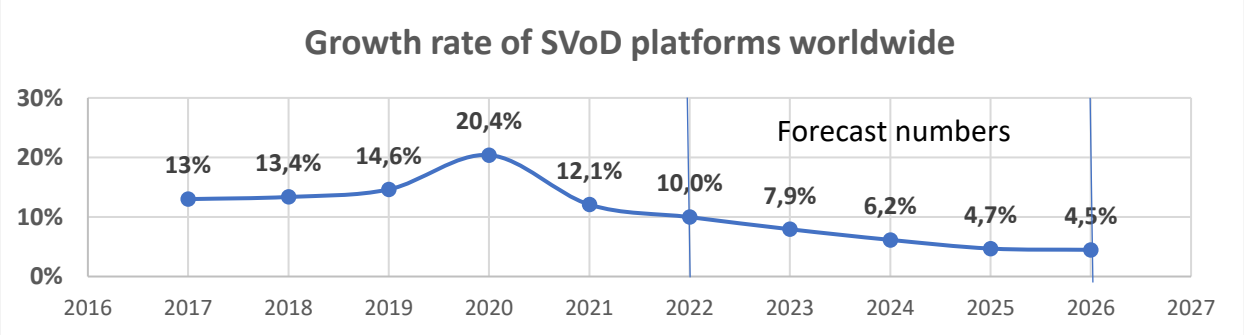

Figure .1 Growth rate of SVoD platforms worldwide

The backbone of the global market for SVoD platforms is the US national market, from which the main market players came: Netflix, Amazon Prime Video, Hulu, HBO Max, Disney+ and so on. The world's top

10 streaming platforms also include one Chinese SVoD service: iQIYI. Next, trends in the national SVoD platform markets for the two major players in this market: the US and China are examined and the reasons for the identified dynamics are derived. The final part describes all the results of the research and provides forecasts for further development of this market.

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UDC 338.242

MODERN INTERNATIONAL BUSINESS STRATEGIES

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ABSTRACT: Review and analysis of international business strategies, selection of the most attractive strategy.

KEYWORDS: business strategy, franchising, market trends, international market.

Globalization continues to affect the economy of each country and the world economy as a whole. Recent trends such as lowering tariffs, developing communications and increasing capital mobility have opened up access for companies to global financial markets and allowed them to develop their business internationally. Entering the international market involves the adoption of modern business development strategies. The strategies chosen should be tailored to the needs and capabilities of each company.

The management of companies that are going to enter the international market needs to take into account a large number of factors while working in global markets. These factors are: competition with foreign companies, the functioning of supply chains and pricing features abroad. The purpose of my research is to study modern international business strategies. In my work, I analyzed the specifics of the international franchising market, in particular the oil and gas sector.

UDC 338.001.36

SOCIAL DIFFERENTIATION, OPPORTUNITIES FOR INCREASING THE INCOME OF THE POPULATION

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ABSTRACT: analysis of the socio-economic problems of the population, identification of the main factors in the emergence of population differentiation and its most acute form - poverty, studying of the mechanism for regulating these processes and using state policy.

KEYWORDS: social differentiation, inequality, poverty, socio-economic development, income distribution, decile coefficient, Ginny coefficient, Lorenz curve, government regulation

The differentiation of society depends on many factors. These factors appear in different spheres of public life. For example, politics or psychology. Income inequality research is based on the system of indicators including the household income. The difference in these indicators is the social differentiation. It is important to mention that inequality in income, along with the inequality in spending and consumption, leads to poverty and forces people to use illegal sources of income, which are a threat to the national economic security of the country. There are many ways to estimate the gap between the rich and the poor. Analyzing the situation in the Russian Federation, I determined that despite the fact, that the inhabitants of the country are so dissatisfied with the ongoing policy to eliminate the poverty, in terms of the decile coefficient, the level of inequality has slightly being decreased since 2007 (Figure 1).[1]

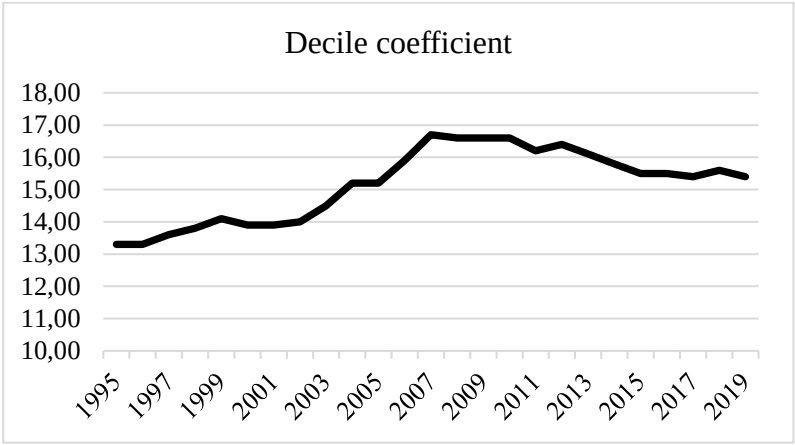

Figure 1. Dynamics of the decile coefficient of funds in Russia from 1995 to 2019

However, according to various sources, in 2022, due to the current political and economic problems, the gap will increase significantly. To increase the income level of the population, the government uses macroeconomic instruments of regulation. In order to realize the goals to improve the well-being of citizens, they should be implemented in cooperation. Social policy could be considered an example of macroeconomic regulation. With the help of it, certain areas of activity are stimulated and various social programs are implemented. Thus, in order to reduce the poverty gap and increase the income level of society, it is necessary to implement: the redistribution of incomes of different groups of society, strengthening the control over the spending of funds from social funds, right taxation, and the fight against corruption.

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UDC 620.9

INVESTIGATION OF CRITERIA FOR ASSESSING RELIABILITY OF ENERGY SYSTEM ACCUMULATION

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ABSTRACT: Criteria for assessing reliability and maintainability for heat supply systems in Siberia are defined, options for a conversion and transition to a higher level of reliability with autonomy and delegation of functions, autonomy and reduction of losses in networks are proposed. The analysis of possible structures of heat storage devices is made.

KEYWORDS: reliability, failure rate, energy systems, energy storage, heat supply systems.

Introduction

In the concept of development of energy systems of Eastern Siberia, Russia and Europe, there is a tendency to transition the organization of energy networks into a single technological and intellectual complex, with the help of which it becomes possible to maintain reliable development and stability of trouble-free operation of energy systems of urban complexes and objects of various purposes.

The object of the research is the analysis of methods and methods for implementing technology and principles of building integrated intelligent power systems with active consumers and technology for regulating energy consumption from the system based on the optimal ratio of the load of own sources and centralized sources. The work also sets out the tasks of conducting surveys to ensure the economic, environmental indicators and reliability parameters of individual gas trigeneration plants that give heat and electricity to the general heat supply network.

Estimated investigation

The reliability of an energy system is a complex property for which a probabilistic assessment of operability is determined with the preservation of the qualities of the elements or the system as a whole for a certain duration of operation of the elements and is due to a number of random factors. According to the regulatory documentation, reliability is the property of the system to perform the specified functions while maintaining the specified performance indicators during the specified operating time. For the energy system and heat supply system with a water coolant, the target functions are the volume of water, the determinated temperature, pressure and degree of purification.

The goals of ensuring the reliability of heat supply have increased due to the high degree of wear of pipelines and TSS equipment, the low technological level of operation of many thermal facilities, the thermohydraulic deregulation of heating networks (TS) and subscriber installations, the management of heat supply of cities with the participation of many owners in a single system and other reasons.

The main criterion of reliability is the probability of trouble-free operation P during a given period t. Energy systems must be sustainable [1], that is, be subject to restoration for a certain recovery time of the failed element τ_{fix}. Systems with the existence of sudden failures with a repair time greater than the permissible downtime of elements have the least degree of reliability:

$$\tau_{fix} > \tau_{addit} \quad (1)$$

This situation can occur with large dimensions of networks, large diameters of pipelines and leads to failure of unreserved and unserved systems.

The sequence of emerging damages of energy networks is a stream of random events or a stream of failures. Average number of failures before defects:

$$m_{cp}(t) = \frac{\sum_{i=1}^{N} m_i(t)}{N} \quad (2)$$

where $m_i(t)$ – is the number of detected failures on a specific section of the pipeline, N – is the number of specific sections of the heat network, t – is the number of years of research.

There are a large number of elements in power supply networks that affect the performance of the network. The number of specific sections of the heat network increases over time, as there is fragmentation and increase as a result of repairs, replacement of elements and other reasons. Therefore, with a very large number of observed objects, it is possible to obtain a characteristic of the failure flow:

$$H(t) = \frac{\sum_{i=1}^{N} m_i(t)}{N} \qquad (3)$$

From (3) it can be seen that with an increase in N network elements the value of the failure flow decreases. Therefore, the energy network requires definition not only with a qualitative improvement in the properties of elements, but also with redundancy, duplication and possible intelligent control of pieces of autonomous networks with structures.

Autonomization with the delegation of some functions, including network elements, reduces the responsibility of a single system for reliability as a whole.

The 3rd generation of the district heating (3GDH) systems in Eastern Siberia require a transition to the 4th generation district heating systems (4GDH) with the formation of energy supply between sectors, which allows for duplication, redundancy, and also somewhat increase (by 0.5%) network useful cycle coefficient due to the improvement of the quality of the coolant in the network. This transition significantly reduces grid losses, improves reliability, and distributes power across energy sectors. This transformation can reduce the load on electrical, thermal and other networks. It is possible it may include the network of energy sources and systems of recycling and trigeneration.

So, expression (3) is transformed into the form:

$$H(t) = \frac{\sum_{i=1}^{N-k} m_i(t)}{N-k} \qquad (4)$$

where k - the number of redundant, redundant points or autonomous systems to maintain trouble-free reliable operation of networks.

As autonomous systems for the study, the concept of development of 4GDH systems was taken, which incorporate alternative energy sources, renewable (wind, sun, etc.), the use of biofuels and secondary energy sources (waste sources). Since networks of this type have a large number of options for duplication [2,3], trigeneration gas installations were taken as the main object of study of the technical solution for the component composition of the thermal energy system [4] within the framework of heat supply systems (HSS).

Summary

Studies have shown the existing 3rd generation district heating systems in Eastern Siberia (3GDH) will allow a trouble-free transition to 4th generation district heating systems (4GDH) but with the formation of links and integration between energy sectors, as well as slightly increase (by 0.5%) the useful cycle coefficient of the heat network by improving the quality of the coolant supply in the network. This transition will reduce losses in networks and distribute energy between various energy sectors, reduce the load on electrical, thermal and other networks. It will also make it possible to include renewable energy sources and recycling and trigeneration systems in the grid.

4GDH systems will play a significant role in providing jobs for the world's future populations and making heat supply possible without the use of fossil fuels and without fossil fuels. The concept of smart heating

networks-4GDH networks for heat supply to the countries of the future will significantly save on fossil fuel reserves.

From the point of view of thermal storage in urban complexes, the advantage of hot stone technology lies in a good technical and economic effect.

When analyzing the impact of changes in excess thermal potentials, changes in losses in networks and changes in the efficiency of converter installations in a district heating system, we can talk about the efficiency of the transition from traditional systems to the proposed new generation systems.

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THE ROLE OF MICROORGANISMS IN METHANE OXIDATION

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ABSTRACT: This review considers the processes of aerobic and anaerobic oxidation of methane by microorganisms.

KEYWORDS: methane, methane oxidation, aerobic methane oxidation bacteria, anaerobic methanotrophic archaea (ANME), anaerobic methanotrophic bacteria.

Methane (CH_4) is the second most abundant greenhouse gas after carbon dioxide (CO_2). Although the methane concentration in the atmosphere is lower than the CO_2 concentration (391 ppm), methane is 25-fold more effective in trapping heat in the atmosphere than CO_2 on a per-molecule basis [2]. Methane on earth is produced which takes place in rice fields, the guts of animals, soils, wetlands, and landfills, as well as in freshwater and marine sediments. For the ocean, an annual rate of methanogenesis of 85–300 Tg CH_4 year−1 has been estimated [6].

Methane is oxidized by methanotrophic microorganisms, both under aerobic and anaerobic conditions. Only microorganisms can carry out this process. Methanotrophs serve as a natural biofilter on the path of methane to the atmosphere and significantly reduce the emission of this greenhouse gas from various sources. In the presence of oxygen, methane is oxidized by aerobic methanotrophic bacteria, which use methane as the sole source of carbon and energy. They are represented by the phylum *Proteobacteri*a (-*alpha* and *–gamma*) and *Verrucomicrobia*. Methanotrophic bacteria play an important role in reducing methane flux emissions from various freshwater and wetland ecosystems [4]. According to some estimates, about 90% of the methane produced in the ocean is consumed by anaerobic oxidation of methane [6]. The anaerobic oxidation of methane (AOM) is an important sink of the atmospheric methane concentration, which significantly impacts global warming. To date, the currently known microorganisms that perform anaerobic oxidation of methane are anaerobic methanotrophic archaea (ANME), belonging of the phylum *Halobacterota*, and bacteria NC10, belonging of the phylum *Methylomyrabiota*. Molecular ecological analysis has shown that they are abundant and have great diversity in many habitats, including freshwater and saline water systems, rice paddy soil, wetland, and have also been obtained in laboratory bioreactors. Within the phylum, ANME forms three clusters: ANME-1, ANME-2 (a,b,c,d), ANME-1. Archaea of the ANME-1 and ANME-2 clusters are very widespread, while members of the ANME-3 cluster are found mainly in deep-water mud volcanoes. Archaea of the ANME-2d cluster, named *Ca. Methanoperedence*, are capable of anaerobically oxidizing methane, using a wide range of electron acceptors, such as nitrate, iron, and manganese. It's known that the process of anaerobic methane oxidation is divided into three types, depending on the electron acceptor used by microorganisms: sulfate-dependent anaerobic methane oxidation (S-DAMO), nitrate-dependent anaerobic methane oxidation (N-DAMO) and metal-dependent anaerobic methane oxidation (M-DAMO). S-DAMO is mediated by a syntrophic consortium of methanotrophic archaea and sulfate-reducing bacteria. This process prevails predominantly in marine ecosystems. N-DAMO predominates predominantly in freshwater ecosystem; it is carried out by ANME-2d archaea and NC10 bacteria. The M-DAMO process occurs in both marine and freshwater ecosystems. This process is performed by arcahea, related to ANME-2d, using Fe(III) and Mn(IV) as electron acceptors [3]. In addition to iron and manganese, Cr(VI) can be used as a potential electron acceptor for AOM [7]. Humics acid can serve as electron acceptors for AOM [1].

Bacteria NC10 perform nitrite-dependent anaerobic methane oxidation (N-DAMO) by intracellular generation of oxygen (O_2) and occupy an intermediate position between aerobic and anaerobic methane oxidizers. The process of AOM coupled to nitrite reduction links the global carbon and nitrogen cycles and NC10 phylum bacteria may have an important role in biogeochemical processes and microbial ecology [5].

Members of other archaeal phyla, such as *Bathyarchaea* and *Korarchaeota* [8], may be involved in the AOM process. *Bathyarchaea* are generalists that dominate anoxic marine and freshwater sediments and have wide metabolic capabilities, including the ability to AOM [9].

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PHYSICAL DEVELOPMENT ASSESSMENT FOR CHILDREN IN CORRECTIONAL SCHOOLS

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ABSTRACT: The students of correctional schools revealed a high frequency of deviations in physical development (PD). 28% were found to be overweight and obese, 13% were undernourished, about 15% of children have low growth rates. These deviations are associated with ineffective prevention and late diagnosis of the problem.
KEYWORDS: physical development, correctional schools, height, weight.

The growth and development of children, as well as their health status, are of great social and medical importance. PD is an integral indicator reflecting the level of health of the population and the socio-economic potential of society. In recent years, there has been a decrease in the number of schoolchildren with normal PD, along with an increase in both deficient and overweight individuals [1].

For children studying in correctional schools and having deviations in the state of health, the analysis of PD is an important indicator of the compensatory capabilities of the body in the disturbed processes of its ontogenesis [2].

The objective of the study: to assess the level of PD of children aged 7-16 years studying in correctional educational institutions.

Materials and methods: to assess PD, 60 children with intellectual and psychological disorders aged 7-16 years were examined at correctional schools №3, №5 in Irkutsk. The main anthropometric indicators were studied: height, weight and chest circumference, using centile tables, international standards of the

World Health Organization, as well as regional standards of the Irkutsk region. To compare and analyze PD different age groups, children were divided into 3 subgroups: 7-10, 11-14, 15-16 years.

The results: PD of 45% (n=27) of children complies with regional standards. Most children have height in the area above and below average values. About 30% of children aged 7-14 and 57% of children aged 15-16 have an average height. In the 7-10-year-old group 2 boys and 1 girl were tall, 2 girls were stunted. 3 boys and 3 girls aged 11-14 years were stunted, 6 boys and 1 girl were tall. Obesity and overweight were revealed in 28% (n=17) of children. The greatest number of cases of obesity were found at the ages of 7-10 and 11-14 years, while no statistically significant differences in gender were found. In addition, malnourished children were found in each age group, and 2 girls aged 14 were severely underweight.

Harmonious development was revealed in 48% (n=29) of the examined children. Disharmony in all age groups is mainly represented by increased weight and reduced body length.

The identified deviations are associated with the symptoms of the underlying disease, non-compliance with the principles of rational nutrition, as well as ineffective prevention and late diagnosis of the problem. In this regard, it is necessary to develop preventive measures aimed at early detection of health abnormalities, as well as optimizing nutrition in children of correctional schools.

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UDC 574.2

EFFECTS OF SODIUM DODECYL SULFATE ON BEETROOT CROP CELLS

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ABSTRACT: the article describes the effect of an anionic surfactant - sodium dodecyl sulfate (SDS) on the release of electrolytes from the cells of the root crop *Beta vulgaris*. We concluded an increase in the output of electrolytes from root crop cells with an increase in the concentration of the toxicant, compared with the control experiment.

KEYWORDS: sodium dodecyl sulfate, bioassay, electrical conductivity, *Beta vulgaris*.

Introduction

Surfactants have a direct toxic effect on living creatures of water bodies. Most likely, surfactants disrupt the functions of biological membranes of animals [1]. Therefore, the aim of the work is to identify the effects of surfactants on *Beta vulgaris* cells.

Objects of study

The object of study in the work was the root crop *Beta vulgaris* (beetroot).The studied toxicant was SDS. The following concentrations of SDS were taken: 2.5; 7.5; 10.0; 20.0 mg/dm^3. For control testing, distilled water was used instead of the toxicant.

Research methods

To assess the toxic effect of SDS, beets were subjected to a 30-minute exposure to this toxicant, after which the release of electrolytes from beet cells was evaluated.

They were placed in a container and washed under running water for 30 minutes. To do this, the electrical conductivity (μS/cm) of distilled water into which the beet was immersed was measured periodically (with an interval of 15-20 minutes) for 90-120 minutes. The electrical conductivity was recorded using a conductometer with an Ekspert-002-2-6-p submersible sensor (Ekoniks-Expert, Moscow).
All experiments were carried out in at least 3 independent experiments with 3 parallel measurements in each. Statistical processing of experimental data was carried out using the Microsoft Office software package. Conclusions are made at the probability of an error-free forecast **P>0.95.**

Research results

Release of electrolytes from *Beta vulgaris* cells increased under the influence of an anionic surfactant sodium dodecyl sulfate, compared with the control experiment. So, when processing beet SDS in concentrations of 2.5; 7.5; 10.0; 20.0 mg/dm^3 for 120 min exposure, the amount of electrolytes released from beet cells was 3.5; 4.4; 5 and 5.2 times more than the initial content in distilled water (2.5 μS/cm), respectively (Fig. 1).While in the electrical conductivity of distilled water, in which control beet samples (i.e., not subjected to SDS treatment) were placed, increased by 2 times from the initial one (from 2.5 to 5.5 μS/cm) in 120 min.

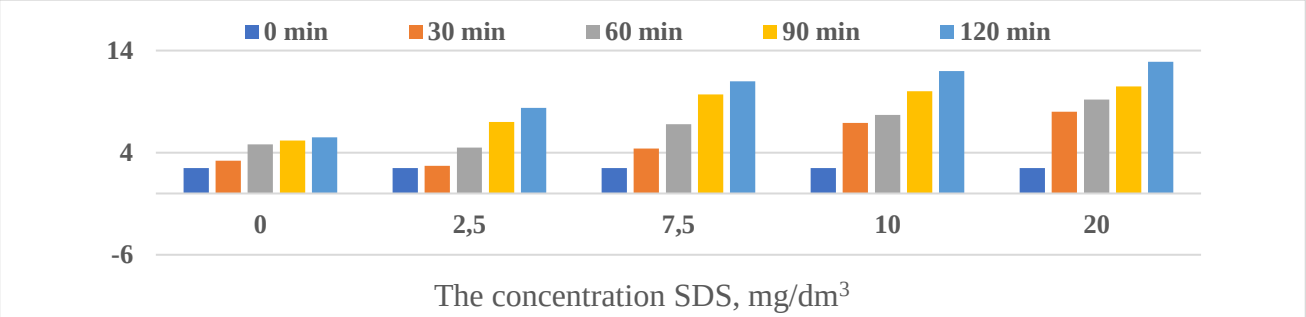

Figure 1 - The output of electrolytes from beet cells subjected to a 30-minute treatment with sodium dodecyl sulfate (2.5; 7.5; 10.0; 20.0 mg/dm^3)

Conclusions

The experiment showed that the anion-active surfactant sodium dodecyl sulfate at a content of 2.5 mg/dm^3 increased the output of electrolytes from *Beta vulgaris* cells, while a direct concentration dependence was observed (an increase in toxic effect with an increase in the concentration of surfactants). From which it follows that surfactants can affect the cells of living beings.

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HISTORY OF BOTANICAL RESEARCH OF THE SOUTHWESTERN COAST OF LAKE BAIKAL

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ABSTRACT: A brief history of botanical studies of the southwestern coast of Lake Baikal is given.

KEYWORDS: botanical research, vegetation, flora, Lake Baikal.

The first information about the flora of the coast was obtained in the second half of the 18th century by researchers Georgi J.G., Gmelin J.G., Pallas P.S. and Steller G.W. They explored the western coast of the lake and Olkhon Island. Thus the first stage of botanical research in the Baikal region began.

The next stage falls on the 19th century and is associated with the works of Turczaninow N.S. On the southwestern coast of the lake, he investigated the vegetation cover in the area of the village of Listvyanka, Mukhor Bay, the mouth of the river Buguldeyka. The data he obtained were included in the monograph «Flora Baicalensi-Dahurica…» (1842–1856).

The active and most productive stage falls on the 20th century. Expeditions led by Sukachev V.N. made a great contribution to the study of the flora of the Baikal region. He made descriptions of vegetation and collected herbarium material in the Olkhon region and Olkhon Island (1912–1928).

In 1912–1940 Professor of the Irkutsk State University Smirnov V.I. and his students explored the southwestern coast of Lake Baikal. Their route ran along the Primorsky ridge, through the villages of Bolshie Koty and Listvyanka, the Bolshaya and Malaya Kadilnaya valleys.

In the early 1950s, Professor M.G. Popov began researching the flora of the Baikal region together with his students. After his death, «Flora of Central Siberia» (1957, 1959) and «Compendium of the flora of the shores of Lake Baikal» (1966) were published.

Since 1956 in addition to vascular plants, Bardunov L.V. was actively studying the bryoflora of the Baikal region (1956–2008). At the same time, Peshkova G.A. studied and characterized the steppe flora of the Baikal region (1956–1974). In the 60–70s Gagarin P.K. studied the vegetation of the steppes of the Olkhon region and the island of Olkhon. The islands of the Maloe More Strait were studied by Petrochenko Yu.N.

Since the early 1980s, Molozhnikov, the author of the monograph «Plant Communities of the Baikal Region» (1986), was studying the plant communities of the Baikal region.

After the foundation of the Pribaikalsky National Park in 1986, its employees Ryabcev V.V., Turuta A.E. and others prepared the project «Cadastre of sites of key importance for the conservation of the biodiversity of the relict forest-steppes of the Baikal region» (1998).

In the 90s, on the instructions of the Irkutsk Center for the Preservation of Historical and Cultural Heritage, employees of the Irkutsk State University carried out floristic and phytocenotic work on the territory adjacent to the Circum-Baikal Railway.

At the present stage of botanical research, work is underway to supplement the «Red Book of the Irkutsk Region» (2001, 2010, 2020), which summarizes current data on the state of natural populations of rare species growing, in particular, on the territory of the southwestern coast of Lake Baikal.

In 2005, the monograph «Compendium of the flora of vascular plants of the Pribaikalsky National Park» was published. In 2008, the «Compendium of the flora of vascular plants of the Irkutsk region» was released. They provide detailed information about the location and habitat of species.

At present, researchers from the Siberian Institute of Plant Physiology and Biochemistry of the Siberian Branch of the Russian Academy of Sciences and Irkutsk State University, with the participation of colleagues from other institutions, are actively studying the flora and vegetation of the Baikal region in Irkutsk.

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TOPICALITY OF RESEARCH OF PLANT-MICROBIAL FUEL CELL TECHNOLOGY

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ABSTRACT: The potential possibility of effective application of plant-microbial fuel cells for the generation of bioelectricity, wastewater treatment and remediation of polluted lands proves the topicality of research in the field of this technology.
KEYWORDS: plant-microbial fuel cell, biodegradation, bioelectricity.

Solving the tasks of reducing emissions of pollutants, eliminating their accumulations and ecological improvement of environmental objects is a priority area for the development of research within the framework of sustainable development goals in accordance with the UN Resolution (United Nations) of 2015 and the Decree of the President of the Russian Federation of 2020 [4].

The depletion of fossil fuel resources (oil, coal, natural gas) is the basis for the search for renewable energy sources [3, 5]. The problem of wastewater treatment and land reclamation is a global challenge [3].

The purpose of this article is to draw attention to the direction of research in the field of plant-microbial fuel cells. The innovative technology of plant-microbial fuel cells (pMFC) is based on the use of the ability of biodegrading microorganisms to utilize the organic fraction of wastewater and soil pollutants as a substrate, while generating an electric current [1–3, 5]. Root exudates of plants are an additional source of nutrients (organic acids, sugars, amino acids, vitamins) for microorganisms [4, 5]. The oxygen released by the roots reduces the internal resistance in the pMFC [2]. The presence of plants, as well as the selection of optimal combinations of plant species and microorganisms in fuel cells, enhances the degradation and electrogenic potential of microorganisms, and increases the productivity of the installation [4].

pMFCs are environmentally friendly and capable of long-term autonomous operation due to the use of pollutants as substrates, the absence of aggressive media and moving elements in the device structure [2, 3]. The cost of installation, operation and maintenance of a pMFC is relatively low [1–3]. There are a number of problems that have not yet been solved, such as low power (up to 131 mW/m2), voltage instability, seasonality, the need to replace plants and electrodes after a certain time [2, 4].

Despite this, pMFC technology has a broad prospect for development as an alternative for energy production and degradation of pollutants in water and soil [1–5].

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HISTORY OF STUDYING THE BRYOPHLORA OF THE ANGARA-SAYAN FLORISTIC REGION

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ABSTRACT: The available literature data on the study of the bryoflora of the Angara-Sayan floristic region are summarized.

KEY WORDS: mosses, bryoflora, Baikal Siberia.

The Angara-Sayan floristic region is located in the west of Baikal Siberia, the boundaries and provisional subdivision of which are accepted in modern concept [1]. The study area includes the Central Siberian plateau in the west and south of the Irkutsk region, the Primorsky ridge, the Khamar-Daban ridge and the Eastern Sayan within the Irkutsk region.

The first briological collections on the territory of the southwestern coast of Lake Baikal were made by L.V. Bardunov in 1956. Afterwards he published a number of works (1958, 1960, 1961, 1963, 1990, etc.), representing the species composition of bryophytes and specificity of their distribution in the mountain systems of the Baikal region. Further study of the flora of mosses and liverworts on the territory of the Baikal region was carried out by researchers of the Siberian Institute of Plant Physiology and Biochemistry, mainly L.V. Bardunov, S.G. Kazanovsky, E.S. Prelovskaya, N.V. Dudareva, etc.

Since 1980, employees of the Department of Botany and Genetics of ISU, primarily E.I. Kosovich-Anderson, have been working in the neighborhood of the settlement Bolshye Koty. Also in 1980, Czech bryologists Z. Soldán, L. Pujmanova (1988) worked in the neighborhood of the settlement Bolshie Koty and Peschanaya Bay.

The macroslope of the Primorsky Range turned to Baikal (from the settlement Listvennichnoye to Cape Kocherikovsky) was studied in sufficient detail. The work of E.S. Prelovskaya (2010) summarized the materials of bryofloristic studies that the author conducted in the period from 2004 to 2009 in the area from the source of the Angara to the border with the Baikal-Lena Nature Reserve [2].

Information about the bryoflora of Khamar-Daban until 1959 was practically absent, in publications one can find only records of individual species. In 1959 T.I. Solodkova in her work defines the vertical change of vegetation on Khamar-Daban, describing the forest vegetation in particular detail and pointing out the characteristics of the moss cover. Data on bryophytes of the Tunkinskaya valley are given in the paper of M.A. Reshchikov and M.P. Tarasova (1962).

From the late 1950s, L.V. Bardunov worked in various districts of Khamar-Daban. The results of his work were partly included in the "Key to the mosses of Central Siberia" (1969) and a number of articles (1958, 1963, 1972, 1986), but none of the works summarized all existing bryological materials.

In the 1980s, Czech bryologists Z. Soldán, L. Pujmanova and J. Váňa published three papers on bryophytes of the mountainous regions of Southern Siberia, including bryophytes of Khamar-Daban. It is important to note that these works contain the first information about the liverworts of Khamar-Daban.

The bryoflora of the Khamar-Daban ridge was studied in great detail by S.G. Kazanovsky in the period from 1989 to 1991. Based on the results of these studies, the work (1993) contains information about the species composition, ecology, ecological confinement, vertical distribution and distribution of bryophytes of Khamar-Daban [3].

The earliest data about the mosses of the Sayan region is contained in the book "Flora of Asiatic Russia" (1914, 1918). The vegetation of the Taishet region of the Irkutsk region was studied in bountiful detail by N.S. Vodopyanova (1964). Thus, a brief description of the moss cover is given for each type of forest.

During the study the bryoflora of the Eastern Sayan, L.V. Bardunov investigated a small part of the Sayan region; the results of these studies were published in several monographs (Bardunov, 1965, 1969, 1974).

I.G. Lyakhova (1969, 1979) was engaged in the study of the marshes of the Eastern Prisayanye. Information about the mosses of the Eastern Prisayanye is also contained in the works of I.G. Lyakhova, I.Ya. Lyakhov (1989); E.I. Kosovich, E.V. Sokolskaya (1996); E.I. Kosovich, E.L. Ivanova (2000). It should be noted that A.N. Vasiliev published several works (1989, 1992, 1995) containing detailed information about the flora of liverworts of the Eastern Sayans.

From 1996 to 2003, N.V. Dudareva (2006) worked on the territory of the Eastern Prisayanye, this work became the first purposeful bryofloristic study of the Eastern Prisayanye [4].

In that way it can be noted that by now, systematic bryophloristic studies cover only a small area of the southern part of the Angara-Sayan floristic district. The studies planned by the author will make it possible to study the bryoflora of the area, to study the ecological distribution of mosses and liverworts in plant communities, depending on the requirements of the species to the growing conditions. The results of the research can be used for botanical mapping, compilation of regional floras, as well as for compiling lists of protected species.

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SOME PHYSIOLOGICAL AND BIOCHEMICAL MECHANISMS OF ADAPTATION OF SPRING WHEAT SEEDLINGS AT DIFFERENT STAGES OF ONTOGENESIS TO HIGH TEMPERATURE

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ABSTRACT: Heat exposure at 37°C causes induced thermotolerance in spring wheat seedlings, due to the increase in the content of water-soluble carbohydrates, the synthesis of heat shock proteins, and the activation of alternative respiratory enzymes. It was shown that the activation of AO and NAD(P)H dehydrogenases differed during moderate heat exposure and heat shock.

KEYWORDS: spring wheat, isolated mitochondria, NAD(P)H dehydrogenases, alternative oxidase, thermotolerance.

Plants during their evolution have developed a number of mechanisms that increase their resistance to stress. It is hypothesized that activation of alternative respiration enzymes helps the plant adapt to stress, but the mechanisms are still not understood. Alternative mitochondrial enzymes include those represented by alternative cyanide-resistant oxidase (AO) and external and internal rotenone-insensitive NAD(P)H

dehydrogenases (ND(P)ex and ND(P)in). The study of these enzymes is an interesting and topical issue, especially in a changing climate.

The aim of this study was to investigate some physiological and biochemical mechanisms that increase the adaptation of 4-day and 8-day seedlings of spring wheat to moderate heat exposure and heat shock.

The object of the study was spring wheat (*Triticum aestivum* L.) of the cultivar «Novosibirskya 29» at the age of 4- and 8-days. Control plants were grown at 23°C/20°C (day/night) 16 h photoperiod, hydroponic in ½ Knop's solution. Temperature influences were chosen on the basis of previously obtained results [3].

We have previously shown that heat exposure at 37 °C caused the development of induced thermotolerance in both 4- and 8-days seedlings with similar adaptive changes. It is noted that 4-day seedlings quickly adapted to high temperature and were more resistant to heat shock compared to 8-day seedlings [3]. Heat exposure at 37 °C led to the heat shock protein synthesis, increase in the content of water-soluble carbohydrates and a decrease in total respiration in the 4-day shoots and 8-day leaves of spring wheat [1]. Preliminary exposure to moderate heat of plants and subsequent heat shock (37°C +50°C) did not lead to significant damage to the membrane, which shows successful adaptation to stress in 4- and 8- days seedlings.

Polarographic analysis was used to study the activity of mitochondria isolated from shoots of 4-day and leaves of 8-day seedlings, and revealed differences and similarities in the rates of oxidation of respiration substrates and the activities of NDex and NDPex. We have shown that NDex and AO contribute to the adaptation of seedlings to heat exposure. It has been shown that heat exposure at 37°C for 6 and 24 h leads to the conjugated functioning of AO and NDex and the increase in the contribution of the alternative pathway to respiration. Under the action of heat shock on seedlings, we observed differences in the functioning of NADH dehydrogenases, which is associated with their stages of ontogeny.

The protein content of these enzymes was analyzed using denaturing electrophoresis followed by Western blotting with antibodies against ND(P)ex (NDB) [4], AO ½ (AS04054, Agrisera, Sweden) and outer membrane protein porin mitochondria [2]. It was noted that the activity of NDex dehydrogenase of mitochondria was associated with some increase in protein content at 37°C in shoots and leaves and under stress in shoots. It was shown that there was a change in the content of monomeric forms of AO. Thus, in mitochondria from shoots of 4-day seedlings, the highest content of AO protein monomers was observed under heat shock, while in mitochondria from leaves of 8-day seedlings, the highest content of AO protein monomers was observed under heat stress.

Thus, moderate thermal exposure leads to the development of induced thermotolerance in spring wheat seedlings. The similarities, differences in the studied physiological, and biochemical parameters depend on the development phase of spring wheat and is probably tissue-specific at high temperatures.

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MOBILE GENETIC ELEMENTS IN TRANSCRIPTOMES OF LAKE BAIKAL COREGONID FISHES

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ABSTRACT: The work identifies the evolutionary role of transposable elements from coregonid fishes of Lake Baikal. A methodology has been developed for «extraction» of transposon sequences from transcriptome by combining step-out PCR and nested PCR together with the Nanopore NGS method.

KEYWORDS: mobile genetic elements, transposable elements, DNA-transposons, Tc1-mariner, coregonid, fish, genetic

For a long time, mobile genetic elements did not attract much scientific attention, because they were considered «junk, selfish DNA», whose functions were unknown. Transposable elements or transposons (TEs) are fragments of DNA sequences that can replicate and move around a genome. In addition to transposons, mobile genetic elements also include plasmids, bacteriophages, and even viruses. During the last decades, major genomic sequencing projects have been carried out that have shown presence of transposons in the genomes of many prokaryotic and eukaryotic organisms. In mammals, transposable elements consist about a half of the genome, and in some amphibians and plants they constitute from 70 to 90% of the genome [1]. Nowadays it is known that TEs have a significant impact on the evolution of genomes, forming their diversity and regulation. It should also be noted that the number of transcribed TE copies increases during hybridization and under various stress conditions (temperature shock, disease) [2].

The ratio of transcribed transposons in salmonids is many times higher than in other vertebrate species, and more than half of these genes belong to the Tc1 superfamily. So, in this work, we focused our attention on DNA-transposons of the Tc1/*mariner* superfamily. This study on the search for transposon sequences in coregonid fishes will give answers to questions: What genes are transposons inserted into? How do they affect the activity of these genes and nearby ones? What negative or positive results for organisms can this lead to? And how does this generally affect the evolution of coregonid in Lake Baikal?

In our study, the objects are coregonid fishes in Baikal: omul *Coregonus migratorius*; lacustrine whitefish *C. baicalensis*; lacustrine-riverine whitefish, pidschian *C. pidschian* and their hybrids of the first generation. We have developed a methodology for «extraction» of transposon sequences from transcriptomes. This is a combination of step-out PCR and nested PCR methods together with nanopore sequencing NGS (NGS – next generation sequencing). These methods will allow us to obtain long target gene transcripts.

It is planned to conduct a large-scale analysis of transposon sequences after selecting all the necessary effective conditions. We will work with samples of different species and populations of coregonid, as well as their hybrids. Fishes grown under temperature stress or other external effects will be used to see how different types of stress affect the activation of transposons in fish transcriptomes and what processes this can lead to in the future.

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