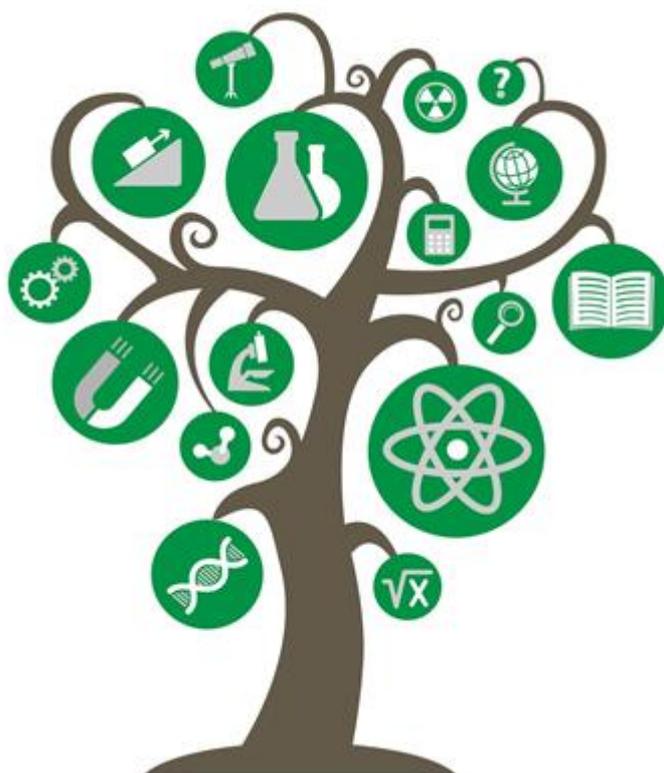


**IRKUTSK SCIENCE CENTER  
THE SIBERIAN BRANCH OF  
THE RUSSIAN ACADEMY OF SCIENCES  
DIVISION OF SCIENTIFIC, EDUCATION ACTIVITY AND EXPERTISE**



**MULTIDISCIPLINARY YOUTH ACADEMIC RESEARCH CONFERENCE**

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

**May 19, 2021**

УДК 811.111'27  
ББК Ш13(Англ)я7

Оргкомитет:

Председатель оргкомитета – Апарцин К. А., доктор медицинских наук, директор ИНЦ СО РАН (Иркутск);

Заместитель председателя оргкомитета – Свердлова Н. А., кандидат филологических наук, доцент, начальник отдела научно-образовательной деятельности и экспертной оценки, заведующий кафедрой педагогики и экспертной оценки ИНЦ СО РАН (Иркутск);

Учёный секретарь – Шелехов В. А., кандидат технических наук, ИНЦ СО РАН (Иркутск).

Ответственные редакторы:

Свердлова Н. А., кандидат филологических наук, доцент, начальник отдела научно-образовательной деятельности и экспертной оценки, заведующий кафедрой педагогики и экспертной оценки ИНЦ СО РАН (Иркутск);

Ефимова Н. Н., кандидат филологических наук, доцент, заведующий кафедрой иностранных языков и философии ИНЦ СО РАН (Иркутск);

Марьясова Е. П., старший преподаватель кафедры иностранных языков и философии ИНЦ СО РАН (Иркутск).

Science Present and Future: Research Landscape in the 21st century: материалы научно-практической конференции с международным участием (19 мая 2021 г.) / Иркутский научный центр Сибирского отделения Российской академии наук. – Иркутск, 2021. – 52 с.

ISBN

Сборник включает в себя тезисы докладов научно-практической конференции с международным участием «Science Present and Future: Research Landscape in the 21st century».

Конференция проведена в соответствии с Планом междисциплинарных мероприятий Сибирского отделения РАН на 2021 год.

## Содержание

### *Секция 1. IT, Engineering, Math*

1. **Victor S. Kondratev** (ISDCT SB RAS) Diagrams to solve inversion problems of injective functions..... 4
2. **Sergei V. Stashkevich** (ESI SB RAS) Algorithm and software complex development for express analysis of transient stability of difficult power systems..... 7

### *Секция 2. Life-sciences on the Cutting Edge of Science*

3. **Anna I. Kuranicheva** IEC SB RAS Neoeotonic features of the formation Kitoyskoe deposit of drinking underground water..... 12
4. **Tatiana A. Semyonova** (IrCh SB RAS) Measurement of light scattering as a promising technique for the analysis of colloidal solutions..... 15
5. **Nadezhda P. Chistova** (FSBSI ESIMER) Markers of endothelial dysfunction in persons with vibration disease and metabolic syndrome..... 16
6. **Elizaveta S. Andreeva** (FSBSI ESIMER) Assessment of long-term effects of wildfire smoke in rats..... 20

### *Секция 3. Geosciences, Solar Sciences and Hydrosociences: New Frontiers*

7. **Olga V. Bezgodova** (IG SB RAS) Ecological and geomorphological situations of the small river basins of the Hamar-Daban (on the example of the Irkut river tributaries).... 22
8. **Andrej A. Voloshin** (IG SB RAS) Chinese Migrants in the Construction Business of the Irkutsk Region: Formal and Informal Organization of Work..... 25
9. **Aleksandr V. Rubtsov** (ISTP SB RAS) Pre-substorm ulf waves observed by multiple spacecrafts..... 29
10. **Irina P. Yakovleva, M.A. Tashchilin** (ISTP SB RAS) Aerosol optical depth spectral characteristics under exposure to forest fire smoke in the Baikal region..... 31
11. **Natalia O. Molchanova** (ISTP SB RAS), **POLETAEV A.S.** (INRTI), **VASILIEV R.V.** (ISTP SB RAS), **CHENSKY A.G.** (INRTI) Review of atmospheric effects associated with lightning discharges..... 34
12. **Anna A. Rybkina, V.I. Kurkin, V.A. Ivanova** (ISTP SB RAS) Diagnostics and investigation of the morphological characteristics of travelling ionospheric disturbances based on the data of near-vertical and vertical sounding of the ionosphere in December 2012 – January 2013..... 39

### *Секция 4. Linguistics and Educational Sciences*

13. **Tatiana S. Paderina** (ISC SB RAS) About the question of ethnocultural stereotypes in the linguistic consciousness of Russians and German..... 42
14. **Xue Bo** (ISC SB RAS) About autostereotypes in nonverbal communication of Russians and Chinese..... 45
15. **Irina I. Zolotareva** (ISC SB RAS) The importance of forming the auditive competence of foundation course students..... 48
17. **Elena P. Mariasova** (ISC SB RAS) On agonality in scientific discourse..... 50



function injective. Let us construct the representation of  $D_f(\gamma)$  in the form of DJD using algorithms from [1]. We denote the resulting diagram by  $R_f(\gamma)$ . This diagram has two terminal vertices, one of which is assigned the character 1, and the other - the special character «?». Each path in  $R_f(\gamma)$  from the root vertex to the terminal vertex naturally (as in the case of ROBDD) generates a set of variable values assigned to the vertices on this path. If  $\pi$  is an arbitrary such path, then by  $X_\pi$  we denote the set of variables assigned to its vertices, and by  $\alpha_\pi$  we denote the set of values of variables from  $X_\pi$  induced by  $\pi$ . Let  $\Pi_\gamma$  Be the set of all paths in  $R_f(\gamma)$  to the vertex «?», And  $\Delta_\gamma$  be the set of sets of values of variables from  $X_{\Pi_\gamma} = \cup_{\pi \in \Pi_\gamma} X_\pi$ , which are induced by all paths from  $\Pi_\gamma$ . Consider an arbitrary  $\pi \in \Pi_\gamma$  and denote by  $\alpha_\pi$  the set of values of variables from  $X_\pi$  induced by  $\pi$ . Let  $\neg\alpha_\pi$  be the set obtained by the bitwise inversion of the set  $\alpha_\pi$ . Using the properties of disjunctive diagrams, one can show that if  $\alpha$  is the satisfying assignment for  $C_f(\gamma)$ , then there exists  $\alpha_\pi \in \Delta_\gamma$ , such that the set of values of the coordinates of the vector  $\neg\alpha_\pi$  forms the subset in the set of values of the coordinates of the vector  $\alpha$ . On the other hand, again from the properties of DJD it follows that the cardinality of the set  $\Delta_\gamma$  is bounded by a polynomial in the size of the formula  $C_f(\gamma)$ . Thus, we can try to find the satisfying assignment of  $C_f(\gamma)$  by solving the SAT problem for CNF of the form  $C_f(\gamma, \neg\alpha_\pi)$  over all  $\pi \in \Pi_\gamma$ . In practice, this approach gives good results only for relatively simple CNFs. If CNF  $C_f(\gamma)$  encodes some difficult problem (for example, inverting a cryptographic function), then CNF of the form  $C_f(\gamma, \neg\alpha_\pi)$  is usually very difficult. However, for a number of injective (in the sense indicated above) functions, diagrams of the form  $R_f(\gamma)$  demonstrate very interesting properties that do not have a rigorous proof, but are confirmed statistically. Specifically, consider the set  $\Pi_\gamma$  and the set  $L_X$  of all literals over  $X$ . For an arbitrary variable  $x \in X$ , consider all paths from  $\Pi_\gamma$ . In every path  $\pi \in \Pi_\gamma$  the variable  $x$  may not appear at all, appear as a literal  $x$ , or appear as a literal  $\neg x$ . Let's go through all the paths  $\Pi_\gamma$ , checking them for a literal from the set  $\{x, \neg x\}$ . If as a result we conclude that the variable  $x$  was included in the path from  $\Pi_\gamma$  as a literal  $l(x) \in \{x, \neg x\}$ , but did not enter as a literal  $\neg l(x)$ , then we call the literal  $l(x)$  unique. Let us denote by  $U_X$  the set of all unique literals in  $L_X$ . As it follows from the properties of DJD, the set  $U_X$  is constructed efficiently (in time polynomial in size  $C_f(\gamma)$ ). For some injective functions, the percentage of coincidences of inversions of unique literals with literals from the satisfying set of CNF  $C_f(\gamma)$  can be very high (80% or more). For a number of functions, this allows one to

construct cryptographic attacks on the functions under consideration, which turn out to be much more effective than the known attacks.

Let us describe an attack of this type on the function  $g_{MD4-43}^{\lambda_1}: \{0,1\}^{128} \rightarrow \{0,1\}^{128}$  from [3], [4]. Consider the inversion of  $\gamma \in Range(g_{MD4-43}^{\lambda_1})$  that have a single preimage. First observation: in diagrams of the form  $R_{g_{MD4-43}^{\lambda_1}}(\gamma)$ , the proportion of inversions of unique literals that coincided with literals from the satisfying assignment was 95% (on average over several tens of tests). Let  $U_X^\gamma, U_X^\gamma \subseteq U_X$  be the set of literals from  $U_X$  that coincide with literals from the satisfying assignment for  $C_{g_{MD4-43}^{\lambda_1}}(\gamma)$ . Choose in  $U_X^\gamma$  a random subset  $\tilde{U}_X^\gamma: |\tilde{U}_X^\gamma| \approx \frac{1}{2} \cdot |U_X^\gamma|$ . The second observation: substitution in  $C_{g_{MD4-43}^{\lambda_1}}(\gamma)$  of inversions of literals from  $\tilde{U}_X^\gamma$  gives a CNF, the full satisfying assignment of which is found in less than 1 minute by the Glucose 3 solver [5]. Consider all paths in  $\pi_\gamma$  in DJD  $R_{g_{MD4-43}^{\lambda_1}}(\gamma)$ . Let's select the set of unique literals  $U_X$ . Choose from  $U_X$   $N = \lfloor \frac{1}{2} \cdot |U_X^\gamma| \rfloor$  literals randomly. We use the classical urn scheme [6] to estimate the probability of coincidence of all these literals with literals present in the satisfying assignment of the original CNF: there are  $Q$  white and  $M$  black balls in the urn,  $N < Q$  balls are chosen at random. The probability that all balls are white is  $P_1 = (Q N)/(Q + M N)$ . The probability of choosing at least one black ball is  $1 - P_1$ . Let  $P_2$  be the probability that for  $S$  repetitions of the experiment there is a sample of  $N$  balls in which there will be no black balls. Obviously,  $P_2 = 1 - (1 - P_1)^S$ . Suppose that we want to achieve a situation where  $P_2 \geq 0,98$  (then almost certainly in one of the  $S$  experiments we will invert our function). For the function  $g_{MD4-43}^{\lambda_1}$ : for  $N = 500$ ,  $Q = 1138$ ,  $M = 55$  (data from experiments), we have the complexity of the attack  $\approx 3 \cdot 10^{19}$  seconds, which is significantly better than the time it takes to call this function by exhaustive search.

### References:

1. Semenov A.A., Otpuschennikov I.V. On one class of decision diagrams // Automation and remote control. 2016. V. 77. №4. P. 617-628.
2. Bryant R. Graph-Based Algorithms for Boolean Functions Manipulation. IEEE Trans.on Comp. 1986. V. 100 (8). Pp. 677-691.
3. Griбанова I.A., Semenov A.A. On the argumentation of the absence of properties of a random oracle in some cryptographic hash functions // Applied discrete mathematics. Application. 2019. N12. S. 95-98.

4. Griбанова I. Семенов А. Constructing a Set of Weak Values for Full-Round MD4 Hash Function // In Proc. of MIPRO 2020. pp. 1174-1179.

5. Audemard G., Simon L. Predicting Learnt Clauses Quality in Modern SAT Solvers // In Proceedings of IJCAI. 2009. Pp. 399-404.

6. Feller W. An Introduction to Probability Theory and Its Applications. Vol.1 // Wiley. 1968.

УДК 621.31

**Sergei V. Stashkevich**

*Melentiev Energy Systems Institute of Siberian Branch of the Russian Academy of Sciences, Irkutsk*

## **AN ALGORITHM FOR EXPRESS ANALYSIS OF TRANSIENT STABILITY OF COMPLEX POWER SYSTEMS**

**Abstract.** The article presents a description of the mathematical model for calculating the transient state of a complex power system. Studies of transient states were carried out using the MATLAB system simulation program. The results obtained show that the proposed algorithm makes it possible to calculate the power system when represented by nodes with power supplies relative to the buses of the electric network.

**Keywords:** электроэнергетическая система, переходный режим, динамическая устойчивость, математическая модель, метод Гаусса.

One of the most difficult stages of calculating the transient stability of complex power systems is transient state calculation.

In the generally accepted practice of transient calculation of the power system, as well as the steady – state stability and transient stability limits, a simplified, one-line mathematical model is used. Replacement schemes of power system elements: generators, transformers, power lines, loads represented by conductivities. The structural representation of the classical mathematical model of power system (EPS) is shown in Fig. 1 in accordance with [1]. The following notation is adopted:

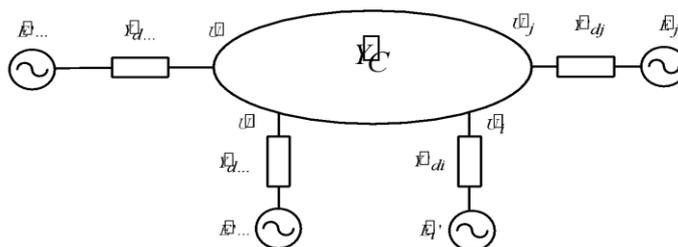


Fig. 1. Mathematical model of the studied power system

$\dot{E}' = [\dot{E}'_i \quad \dot{E}'_j \quad \dots]$  – vector of electromotive forces (EMF) of synchronous generators,

$\dot{Y}_d = [Y'_{di} \quad Y'_{dj} \quad \dots]$  – vector of conductivities of synchronous generators,

$\dot{U}_C = [\dot{U}_i \quad \dot{U}_j \quad \dots]$  – system nodal stress vector,

$\dot{Y}_C = \begin{bmatrix} Y_{i1} & Y_{i2} & Y_{i3} & \dots \\ Y_{j1} & Y_{j2} & Y_{j3} & \dots \\ \dots & & & \end{bmatrix}$  – system nodal voltage matrix;

The system equations are shown in the form of the nodal voltages equation:

$$\dot{Y}_C \cdot \dot{U}_C = (\dot{E}' - \dot{U}_C) \cdot \dot{Y}_d \quad (1)$$

express

$$\dot{Y} \cdot \dot{U}_C = \dot{E}' \cdot \dot{Y}_d \quad (2)$$

where  $\dot{Y} = \dot{Y}_C + \dot{Y}_d$  – total conductivity matrix.

The motion equations for the rotors of synchronous generators are determined by a well-known expression, the solution of which is made by numerical integration on the time scale:

$$\frac{\partial^2 \delta}{\partial t^2} = \frac{1}{T} \cdot (P_T - P) \quad (3)$$

where  $P = [P_i \quad P_j \quad \dots]$ ,  $P_T = [P_{Ti} \quad P_{Tj} \quad \dots]$ ,  $\delta = [\delta_i \quad \delta_j \quad \dots]$  – vectors of electromagnetic power of generators, mechanical power of turbines of generators, angles of rotors of generators.

Electromagnetic power of a synchronous generator  $P$  is determined by the expression:

$$P = \text{Re} (\dot{E}' \cdot \hat{I}) = \text{Re} (\dot{E}' \cdot (\hat{E}' - \hat{U}) \cdot \hat{Y}'_d) \quad (4)$$

$\hat{E}'$ ,  $\hat{U}$ ,  $\hat{Y}'_d$  – complex - conjugate vectors of EMF of synchronous generators, nodal voltages of the system, conductivities of synchronous generators.

The complete EPS model is described by differential and algebraic equations for the corresponding elements of the electrical system, and must take into account both electromechanical and electromagnetic transient state, taking into account the action of automatic excitation control systems and turbine speed regulators of synchronous generators, where inductive and capacitive conductivity of the electrical network does not depend on the frequency.

The mathematical model of the power system described by equations (2) - (4) is a simplified model adopted with certain assumptions. Considering that the angles of synchronous generators and the rotational frequencies of synchronous generators change much more slowly than the electrical parameters, due to the

inertia of the rotating masses of the rotors of synchronous machines, in this work they can be taken constant, and the dependence of the inductive and capacitive conductivity of the electrical network on the frequency can be neglected.

In a similar way, you can neglect the change in the EMF of the synchronous generator, and take it constant. Changes in the EMF of synchronous generators arise due to the influence of the aperiodic component of the currents flowing in the stator winding at the moment of the electromagnetic transient state [2], and therefore are very short-lived.

Taking into account the above considerations, the algorithm for calculating the transient process can be represented as follows:

- 1) At the first integration step after switching in the network, we calculate the system of equations (2) by the direct course of the Gaussian elimination method;
- 2) We determine the voltages at the nodes by the reverse course by the Gaussian elimination method,  $E' = const$  from the previous step;
- 3) We integrate (3) at a step, we determine the angle  $\delta_i$ , taking into account  $\delta_{i-1} \approx \delta_{i-2}$ , we find  $\delta_{i-1}$ ;
- 4) If there are no commutations in the network, we go to step 2;
- 5) If there is a commutation, we perform it, i.e. we transform the network taking into account the configuration change, we go to step 1;
- 6) The end of the calculation is made in time or when a violation of stability is detected;
- 7) Checking the correctness of the calculation algorithm: the angles of the generators do not change when calculating the network without disturbance.

As a test scheme, the four-machine scheme in Fig. 2, shown in [3], is considered. The equivalent scheme parameters are presented in tables 1 - 3.

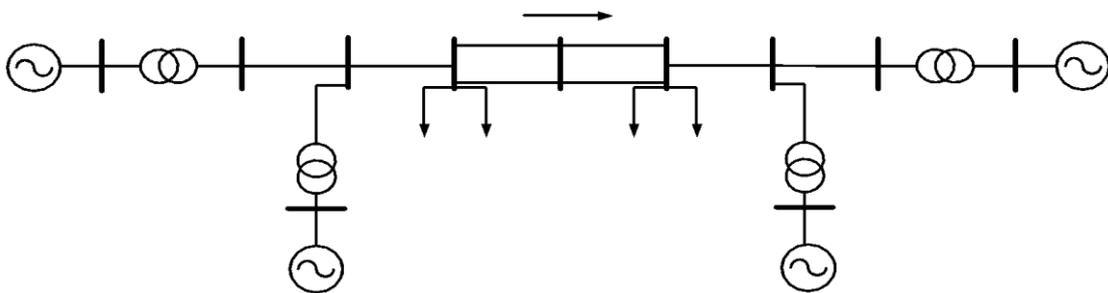


Fig. 2. EES test scheme

Table 1. Generator parameters

Equipment / parameters	G1	G2	G3	G4
$X_d$	$j17,63$	$j17,63$	$j17,63$	$j17,63$
$X'_{d,C}$	$-j0,057$	$-j0,057$	$-j0,057$	$-j0,057$

$EB_d$ ,	$236,9e^{j20,2}$	$236,9e^{j10,5}$	$236,9e^{-j6,8}$	$236,9e^{-j17}$
----------	------------------	------------------	------------------	-----------------

Table 2. Parameters of transformers, loads

Equipment / parameters	T <sub>1-5</sub>	T <sub>2-6</sub>	T <sub>3-11</sub>	T <sub>4-10</sub>	H7	H9	C7	C9
$\varnothing_{\eta}$ ,	$j8,82$	$j8,82$	$j8,82$	$j8,82$	$54,13 - j5,59$	$29,84 - j1,69$	$j264,5$	$j151,14$
$X_T, C$	$-j0,11$	$-j0,11$	$-j0,11$	$-j0,11$	$0,0183 + j0,001$	$0,033 + j0,0019$	$-j0,0038$	$-j0,0066$

Table 3. Power transmission line parameters

Equipment / parameters	L <sub>5-6</sub>	L <sub>6-7</sub>	L <sub>7-8</sub>	L <sub>8-9</sub>	L <sub>9-10</sub>	L <sub>10-11</sub>
$\varnothing_{\eta}$ ,	$1,32 + j13,23$	$0,529 + j5,29$	$2,9 + j29,1$	$2,9 + j29,1$	$0,529 + j5,29$	$1,32 + j13,23$
$\epsilon_{\eta}$	$0,0075 - j0,0748$	$0,0187 - j0,1872$	$0,0034 - j0,034$	$0,0034 - j0,034$	$0,0187 - j0,1872$	$0,0075 - j0,0748$
$\epsilon_{\eta} / 2 \cdot 10^{-6}$	$j41,66$	$j16,67$	$j363,6$	$j363,6$	$j16,67$	$j41,66$

To calculate the transient state, a program was developed in the base language MATLAB, where the network parameters are entered in the form of text files, processed, and output as dependences of the mutual angles of the generators on time. At the moment of the disturbance, the value of the short-circuit shunt is introduced into the calculation, which simulates the damage of the one chain in the two-chain power line: power line (PL) –7–8. At the disconnection moment of the damaged circuit of the overhead PL –7–8, the matrix of the conductivity of the post-emergency mode is introduced into the calculation, with the doubled conductivity of the overhead line –7–8.

By analyzing the characteristics of the change in the mutual angles of the rotors of synchronous generators, a conclusion is made about the preservation or violation of transient stability. The obtained characteristics are shown in Fig. 3.

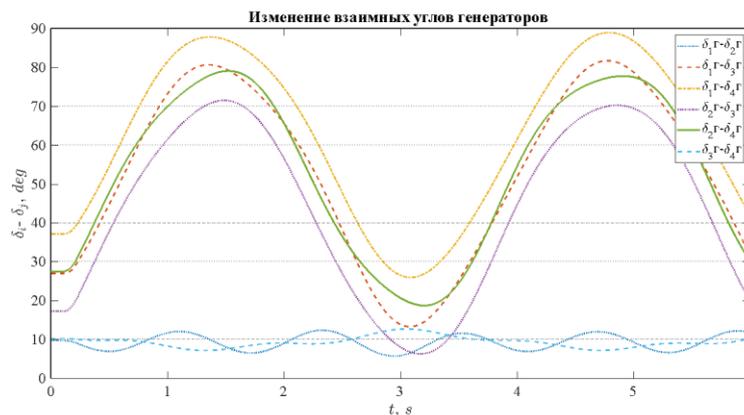


Fig. 3. Changes in the mutual angles of the generators

To confirm the algorithm for calculating the transient state, the active powers were calculated through the intrinsic and mutual conductances of the branches, which are determined by the method of converting the circuit (a wye to a

triangle and vice versa, by converting a multi-ray wye, etc.), or by the method of excluding nodes according to Gaussian to such form, where the EMF of each generator is connected directly to the EMF of every other generators by only one conductivity [2]. The obtained calculations are similar to the calculations obtained by the proposed method from the mathematical model (2) - (4).

It is shown that in comparison with the classical approach of transforming the network into a multipole of intrinsic and mutual conductivities relative to the nodes of EMF application, the considered method gives the same results when simulating electromechanical transient processes of EPS under disturbances in time.

### **References:**

1. Golov P.V., Sharov Yu.V., Stroyev V.A. System of mathematical models for calculating transient processes in complex power systems // Electricity. — №5. — 2007. — p. 2-11.
2. Zhdanov P.S. A stability issues of power systems. / Edited by L.A. Zhukov. - M.: Energy. 1979.
3. Kundur P. Power system stability and control. New York: McGraw-Hill, 1994.



## Life-sciences on the Cutting Edge of Science

УДК 556.332.629

**Anna I. Kuranitcheva**

*Joint-stock company "Urangelogorazvedka" Angarsk Geological Expedition, Irkutsk*

### **NEOTECTONIC FEATURES OF THE FORMATION KITOYSKOE DEPOSIT OF DRINKING UNDERGROUND WATER**

**Abstract.** The article focuses on the neotectonic features of the formation of overburdened sections of the Kitoiy River valley. These sections are composed of genetically constructive alluvium. Due to such structural features, the thickness of the aquifer increases and the flow rate of wells becomes an order of magnitude higher than beyond the contours of over-deepened sections. The authors analyzed the studies carried out from 1956 to 2020 and suggested that within the Belsk neotectonic zone, there are deposits with sufficient quality and quantity.

**Keywords:** neotectonics, drinking underground water, pollution, Kitoyskoe deposit.

Modern water supply to the population of Angarsk is carried out at the expense of the surface waters of the Angara River. This water is experiencing an anthropogenic load and is subject to pollution. There are various enterprises and the urban agglomeration of Irkutsk located upstream of the Angara. These enterprises contribute to the constant lower-grade of quality surface waters. The level of the river drops sharply in arid years to an extent that the head of the water intake is partially exposed. These cases were observed in 2017-19. This fact can cause the cessation of water production in some arid periods. It is especially dangerous to rein up the water supply to the water supply in winter times. Therefore, for the household and drinking water supply of the population of the city of Angarsk, a reliable source of water of good quality is needed, not vulnerable to pollution. The Kitoyskoe deposit of drinking groundwater is suitable for these purposes.

Identify the genesis of this deposit, to note its part in the development of the Belsk neotectonic zone.

The deposit is located in the foothill part of the Kitoi valley, 16 km west of Angarsk. Localization of fresh groundwater resources in this area occurs with features of neotectonic development [1].

The origin of the Kitoi riverhead begins in the fold zone of the Eastern Sayan Ranges. Then the valley extends onto the Siberian Platform and outcrops on the surface in the southern part. It merges with the Angara valley within the Irkutsk-Cheremkhovsk Plain.

According to Voskresensky S.S. and Grosswald M.G., the foothills of the Eastern Sayan Ranges are divided into two modern (neotectonic) subsidence zones: Belsk and Angarsk zones. They extend parallel to the foot of the Eastern Sayan Ranges.

The Belsk neotectonic zone Kitoyskoe deposit of drinking underground water is hosted. It extends from the Olkha-river through the middle reaches of the Irkut, Kitoi, Bolshaya and Malaya Belaya rivers to a large expansion of the valleys of the Oka and Zima rivers. The systems of river valley zones with the greatest neotectonic subsidence are characterized by the wide development of floodplains, low above-floodplain river and lake systems with the formation of constitutive alluvium in sections of the stratum (overdeep areas of valleys with nested terraces), in which the groundwater is localized. The subsidence zones are separated by a gentle undulating uplift, where genetically perstructive alluvium of low thickness is predominantly distributed. The hinges of the zones plunge and rise several times, which is associated with the presence of waves of subsidence and subsidence, parallel to the ridges of the Baikal direction and crossing the Sayan direction almost at right angles. These two systems of wave motions, when interacting, created a peculiar lattice morphostructure of the Irkutsk-Cheremkhovo plain. The largest Cenozoic depressions are formed (including the Kitoi depression) at the intersection of the zones of subsidence of the Sayan and Baikal directions.

Kitoyskoe deposit is confined to one of the overburdened sections of the river Kitoi valley, formed by constrictal alluvium with a thickness of up to 40-60 m, represented by boulder-gravel-pebble material with a sandy aggregate with high filtration rates. The subsoil area under consideration is located near the Sayan foothills, from where a powerful underground runoff is directed, which is localized in the wave depressions of the Belsk zone, due to which the Kitoyskoe deposit of drinking groundwater was formed. Waters are not only fresh in composition, but also, further from the Sayan region, saline, since there is a discharge of salty, brackish waters below the bearing Jurassic aquifers.

The reserves of the Kitoyskoe deposit, as of 2014, amount to 207.667 thousand m<sup>3</sup> / day, another 80 thousand m<sup>3</sup> / day are excluded from the state balance. According to the results of revision and verification works in 1993, the

average filtration coefficient for the deposit is close to 122 m<sup>3</sup> / day, and the average grade of water permeability coefficient is 3400 m<sup>2</sup>/day. Such high rates were found on the territory of the field, outside of it they decreased. In terms of water quality, the deposits meet the standards. In some of its areas, increased mineralization, high content of iron, manganese is possible; water treatment can be used.

Based on the above geological and geochemical study, the following conclusions can be drawn:

1) Formation of the similar underground water deposits is formed due to neotectonic wave oscillations.

2) The analysis also made it possible to assume that in the Belsk zone there are other sections of modern subsidence, on the territory of which there may be the same overdeep dislocations with waters of sufficient quantity and quality that can be used in water supply.

#### **References:**

1. Florensov N.S., Adamenko O.M., Dolgushin I.Y. et al. Plateau and lowlands of Eastern Siberia. Series "The history of the relief development in Siberia and the Far East." Science, Moscow, -1971. -P. 33.
2. Shestakov A.M., Skrebnev E.I., Blokhin Y.I. Hydrogeological additional study on a scale of 1: 200,000 with GEIK-200. Sheet N - 48 - XXXII (Angarsk), Malta, - 2003. -P. 148-149.
3. Angarsk geological expedition. Justification of exploration work at the Kitoyskoe deposit of drinking groundwater for drinking and domestic water supply for Angarsk population and the Angarsk district of the Irkutsk region, Irkutsk, - 2018. -P. 5.
4. Lumpov I.A., Results of revision and verification work at the Kitoyskoe deposit of fresh groundwater with the calculation of operational reserves as of 01.01.94. Irkutsk, -1994. TGF Report, -P. 38-39, 55-56.

***Scientific Supervisor:*** *Andrey G. Vahromeev*  
Doctor of Science (Geology and Mineralogy),  
Institute of Earth crust, SB RAS, Irkutsk.

***Research advisor:*** *Yuri K. Lankin*

**Tatyana A. Semyonova**

*A.E. Favorsky Irkutsk Institute of Chemistry, SB RAS, Irkutsk*

## **MEASUREMENT OF LIGHT SCATTERING AS A PROMISING TECHNIQUE FOR THE ANALYSIS OF COLLOIDAL SOLUTIONS**

**Abstract.** The ZetaPALS device, which allows analyzing colloidal solutions, was purchased. The particle sizes and their characteristics can be obtained using it.

**Keywords:** light scattering, colloidal solutions, nanoparticles, DLS, ELS, fluctuation relaxation parameter.

A few years ago, the Favorsky Institute of Chemistry acquired the ZetaPALS device for measuring light scattering and finding zeta-potential of solutions. The device allows one to quickly and accurately determine the size and stability of colloidal particles in a solution.

Many materials created on the basis of colloidal systems have unique performance properties: high strength, lightness, impact and heat resistance. In this regard, much attention is paid to the creation and study of dispersed systems.

One of the simplest methods to solve this problem is to measure the intensity and nature of the medium light scattering.

The relationship between these parameters was identified around 1990 and is now presented as the following formula:

$$D = k_B \times T / 3 \times \pi \times \eta(t) \times d$$

Here  $D$  is fluctuation relaxation parameter,  $k_B$  is Boltzmann constant,  $T$  is the temperature in K,  $\eta(t)$  (in centipoises) is the viscosity of the liquid, and  $d$  is the diameter of the particles. Parameter  $D$  is the most important value that allows us to estimate the size of the particles in solutions.

Dynamic light scattering or DLS, a separate type of light scattering survey, is built around it.

Oscillations of particles in the solution, their movement and collision occur constantly. They are described by the Brownian motion of particles. However, it leads to an interesting effect: alternation and short-term rarefaction and thickening of the medium, which will scatter light with different intensities. It has also been noted that this occurs with constant oscillations, i.e. the larger the particles in the solution, the bigger the "step" of oscillations.

Another useful feature of this recording type is the ability to determine the shape of the particles, since non-spherical particles will scatter light with different intensities depending on the angle of incidence of the laser. The nature of oscillations, in turn, can give a scientist information about the polydispersity of the medium.

There is a whole range of devices that allow you to work in the DLS measurement mode. One of such devices is ZetaPALS. PALS is the abbreviation for *Phase Analysis Light Scattering* – an extension to the method of electrophoretic laser light scattering (ELS). ELS is used to measure the speed of moving particles that scatter laser light.

The complete set of the device allows one to measure particles in various solvents, while varying temperature and acidity of the solvent. With this device, it is possible to study polymer solutions, as well as nanocomposites.

One of the works carried out in recently was the study of silver nanoparticles growth in a polymer matrix consisting of a block copolymer VT-VTES. This comprehensive work covers such topics as the dependence of nanoparticles size on the composition of copolymers, the suitability and efficiency of using polymers containing silicon and heterocyclic fragments in their composition.

In general, the study of light scattering is a powerful tool for obtaining information about liquid colloidal systems. The information obtained in this way can both confirm and supplement the information available to a researcher and penetrate deep into the phenomena occurring in the solution.

*Scientific supervisor:*

*Alexander S. Pozdnyakov,*

Ph.D. (Chemistry),

A.E. Favorsky Irkutsk Institute of Chemistry,

SB RAS, Irkutsk

УДК 616-008.9+613.6:616.1

**Nadezhda P. Chistova**

*Laboratory of immune, biochemical and molecular genetic studies, East-Siberian Institute of Medical and Ecological Research, Angarsk*

## **MARKERS OF ENDOTHELIUM DYSFUNCTION IN INDIVIDUALS WITH VIBRATION DISEASE AND METABOLIC SYNDROME**

**Abstract.** The aim of the study was to assess the modifying effect of metabolic syndrome on the state of the endothelium in individuals with vibration disease. The study included 88 men

with vibration disease, 42 of them with metabolic syndrome. The study of markers of endothelial dysfunction was carried out by the method of enzyme immunoassay. It was found that individuals with vibration disease are characterized by high levels of angiotensin I and endothelin-1, which are markers of endothelial dysfunction. At the same time, the content of endothelin-1 in the blood of patients with vibration sickness and metabolic syndrome was higher than in patients without metabolic syndrome.

**Keywords:** endothelium dysfunction, metabolic syndrome, angiotensin-I, endothelin-1.

Vibration disease is a chronic occupational disease that occurs with prolonged exposure to high levels of occupational vibration, characterized by damage to the peripheral vascular, nervous systems as well as the musculoskeletal system [1]. An employee contacts with vibration when working on transport and with various equipment (vibration platforms, jackhammers, cement saws, metalworking machines, etc.). After 5 years of contact with vibration, signs of vibration disease may appear. Occupational disease classification of the World Health Organization doesn't contain Russian term "vibration disease", therefore, there are different formulations in the english-speaking literature. Pathology caused by mechanical vibration classified as Raynaud's syndrome, neuropathies and joint arthrosis [2].

Endothelium dysfunction is a key component in the pathogenesis of vibration disease. The vascular endothelium is a powerful secretory organ that synthesizes a huge amount of biologically active markers. There are vasoconstrictors (endothelin-1, angiotensin), vasodilators (nitric oxide), anticoagulants, vascular growth factors, pro-inflammatory and anti-inflammatory substances. During the formation of endothelium dysfunction, the balance of vasoactive substances produced by the endothelium shifts towards vasoconstrictors [3]. Endothelium dysfunction can be aggravated by metabolic syndrome, a state of impaired fat and carbohydrate metabolism, accompanied by increased blood pressure [4].

Research objective is to evaluate the modifying effect of the metabolic syndrome on the state of the vascular endothelium in individuals with vibration disease.

Group I included 42 people with a diagnosis of vibration disease combined with metabolic syndrome. The comparison group consisted of 46 patients with vibration disease. The average age of the patients was 55,1 and 53,3 years old, respectively. The groups are comparable in age.

Inclusion criteria in investigation: male gender, age from 40 to 60 years, signed informed consent, absence of acute diseases and chronic diseases in the acute stage.

Additional criteria for inclusion in group I: the presence of 3 or more components of the metabolic syndrome: (abdominal obesity - waist size more than 94 cm, in combination with any 2 of the following criteria - blood pressure more than 140/90 mmHg; triglycerides (TG) levels more than 1.7 mmol/L; high-density lipoprotein cholesterol (HDL) concentration less than 1.0 mmol / L; low-density lipoprotein (LDL) cholesterol levels more than 3.0 mmol / l; amount of the plasma glucose more than 6.1 mmol/L, or impaired glucose tolerance).

Criteria exclusion from the study: the presence of a history of stroke or heart attack, coronary heart disease, cancer, kidney or liver failure, tuberculosis of any localization, autoimmune diseases.

Blood serum samples were taken from the patients, were frozen and stored at a temperature of -70°C. To determine the content of angiotensin-I and endothelin-1 in serum, the enzyme-linked immunosorbent assay (ELISA) kits were used. During this procedure, the sample antigens, detecting agents, substrate, and stop reagent interact with polyclonal antibodies sorbed in the wells of the tablet. The optical density was determined at a wavelength of 450 nm, using an ELx800 photometer (BioTek, USA).

The STATISTICA 10 application software package was used for statistical data processing. The Shapiro-Wilk test was used to determine whether the type of data distribution corresponds to the normal one. The nonparametric Mann-Whitney test was used to evaluate the quantitative data in the study groups. The results are submitted by median and an interquartile range.

The content of angiotensin I in the blood of group I patients was 675.0 (265.4-1323.0) pg/ml. Its levels in the comparison group are 436.35 (224.6-1315.0) pg/ml. There were no statistically significant differences between the groups, while the levels of angiotensin I exceeded the reference values in both groups (25 pg/ml), which indicates an increase in the activity of the renin-angiotensin-aldosterone system (RAAS). Vibration affects the endothelium, forming endothelium dysfunction. In this case, the balance of substances synthesized by the endothelium is disturbed. Angiotensin I is converted to angiotensin II by the action of an angiotensin-converting enzyme (ACE) synthesized by the endothelium in greater quantities. Angiotensin II stimulates the secretion of aldosterone by the adrenal glands. Vibration exposure also affects the hypothalamic-pituitary-adrenal system directly, which contributes to high blood pressure levels [5]. High levels of aldosterone promote increased blood pressure [6].

The content of endothelin-1 in the blood of patients of group I pg/ml was higher than in the comparison group and amounted to 75.85 (56.7-87.2) pg/ml. In

patients without metabolic syndrome, the concentration of endothelin-1 corresponded to 59.95 (54.2-77.0) pg/ml. The values in both groups exceeded the reference values (8.5-45.1 pg/ml). High levels of endothelin-1 is specific endothelial response to vibration. Endothelin-1 binds to Endothelin A receptor on smooth muscle cells, which triggers vasoconstriction and increases blood pressure [7]. The metabolic syndrome is also accompanied by an increase in the content of endothelin-1 in the blood serum [8]. This moment aggravates the manifestations of endothelium dysfunction in individuals with vibration disease; however, this pathogenetic mechanism is not sufficiently studied.

In individuals with vibration disease, angiotensin I and endothelin-1 levels are recorded above the reference values, which is a manifestation of endothelium dysfunction. The content of endothelin-1 in the blood of patients with vibration disease and metabolic syndrome is higher than in patients without metabolic syndrome.

#### **References:**

1. National Manual of Occupational Pathology. Edited by N. F. Izmerov. M.: GEOTAR-Media, 2011. 784. (in Russian).
2. International Statistical Classification of Diseases and Related Health Problems in Occupational Health. Geneva. 1999.
3. Voinov V.A. Pathophysiology of the heart and blood vessels. M.: Binom. 2020; 208 (in Russian).
4. Islamgaleeva Z.M., Mingazetdinova L.N., Kabilova A.V., Bakirov A.B. Interdependence of endothelial dysfunction with polymorphism of SELP and VEGF genes in women with metabolic syndrome and arterial hypertension. *Medicinskij vestnik Bashkortostana*. 2017; 6 (72): 21-26 (in Russian).
5. Bodienkova G. M., Ivanskaya T. I., Lizarev A. V. Immunopathogenesis of vibration disease. *Acta Biomedica Scientifica*. 2006; 3: 74-77. (in Russian).
6. Ghafar M.T.A. An overview of the classical and tissue-derived renin-angiotensin-aldosterone system and its genetic polymorphisms in essential hypertension. *Steroids*. 2020; 163: 1-13.
7. White, C. R., Haidekker, M. A., Stevens, H. Y., Frangos, J. A. Extracellular signal-regulated kinase activation and endothelin-1 production in human endothelial cells exposed to vibration. *The Journal of physiology*. 2004. 555(2): 565-572.
8. Golivec T. P., Dubonosova, D. G., Osipova, O. A., Petrova, G. D. Endothelin-1 effects in the development and progression of metabolic syndrome and other socially significant non-communicable diseases (literature review). *Aktual'nye problemy mediciny*. 2017. 39(19): 5-19 (in Russian).

**Scientific supervisor:**  
*Ludmila B. Masnavieva,*  
Doctor of Science (Biology), East-Siberian  
Institute of Medical and Ecological Research,  
Angarsk.

**Scientific advisor:**  
*Irina V. Kudaeva*  
Doctor of Science (Medicine), East-Siberian  
Institute of Medical and Ecological Research,  
Angarsk.

УДК 615.9:57.044:502.08

**Elizaveta S. Andreeva**

*Laboratory of Biomodeling and Translational Medicine, Federal State Budgetary  
Scientific Institution “East-Siberian Institute  
of Medical and Ecological Research”, Angarsk*

## **ASSESSMENT OF LONG-TERM EFFECTS OF WILDFIRE SMOKE IN RATS**

**Abstract.** The study of toxic effects of wildfire smoke on reproductive function is the most important scientific problem at present. The long-term consequences of exposure to the smoke of wildfires were revealed, manifested in the offspring of the first generation in the form of impaired behavior and cognitive abilities. The recovery period after prolonged smoke intoxication, which is 60 days and is comparable in duration with the duration of spermatogenesis in rats, is important for reducing the risk of developing CNS disorders in offspring.

**Keywords:** wildfires; rats; offspring; CNS, reproductive system.

The negative impact of wildfire smoke on human health is a unique interdisciplinary problem for the modern scientific community. The regular occurrence of large-scale forest fires, which often become a natural disaster, requires the adoption of scientifically-based comprehensive measures to protect the population. The content of a significant amount of potential repro – and genotoxicants in the composition of the wildfire smoke, such as acetaldehyde, formaldehyde, benzene, toluene, chloromethane, etc. determines the need to study their influence on the functional status of the reproductive system and the health of subsequent generations in model experiments.

The aim of this study was to investigate the behavior and cognitive abilities of sexually mature offspring obtained from male white rats exposed to wildfire smoke.

Experiments were carried out on 60 white male rats and 120 adult males of their offspring. The duration of exposure was 4 weeks, 5 days a week for 4 hours a day, using a previously developed model of a wildfire [1]. To obtain progeny, exposed males were mated with intact females immediately after the exposure and in the long-term period after exposure. Examination of adult progeny was performed, using the "open field", Morris water maze, and histological examination of brain tissue.

The study revealed behavioral and cognitive changes in the offspring of male rats exposed to forest fire smoke: a significant decrease in motor activity and a higher level of negative emotional state, a violation of spatial memory. Individuals from offspring obtained in the long-term period after exposure to smoke showed normalization of the studied parameters to the background values.

Many aspects of the toxic effects of forest fire smoke on reproductive health remain unexplored. We assume that the most significant contribution to the formation of disorders in offspring is made by inhaling a multicomponent mixture of toxic gases and solid particles with a high oxidative potential and probably inducing changes in the genome and / or epigenome in male germ cells [2]. It should be noted that when mating occurs in the long-term period after exposure to forest fire smoke, the resulting offspring did not show pronounced behavioral and cognitive disorders, which indicates the importance of the recovery period for reducing the risk of developing CNS disorders in the offspring through genetic/epigenetic imprinting.

#### **References:**

1. Вокина В.А., Новиков М.А., Елфимова Т.А., Богомолова Е.С., Алексеенко А.Н., Соседова Л.М. Исследование воздействия эмиссии от лесных пожаров на морфофункциональное состояние центральной нервной системы белых крыс. *Гигиена и санитария*. 2019; 98 (11): 1245-1250. <http://dx.doi.org/10.18821/0016-9900-2019-98-11-1245-1250>
2. Williams K.M., Franzi L.M., Last J.A. Cell-specific oxidative stress and cytotoxicity after wildfire coarse particulate matter instillation into mouse lung. *Toxicol Appl Pharmacol*. 2013; 266 (1): 48-55. doi: 10.1016/j.taap.2012.10.017

**Scientific Supervisor:**

*Vera A. Vokina,*  
Ph.D. (Biology).

**Research advisor:**

*Larisa M. Sosedova,*  
M.D., Professor.



## **Geosciences, Solar Sciences and Hydrosciences: new Frontiers**

УДК 551.435.1 (571.55)

**Olga V. Bezkodova**

*Laboratory of Geomorphology, Institute of Geography V.B. Sochava, Siberian  
Branch of the Russian Academy of Sciences, Irkutsk*

### **ECOLOGICAL AND GEOMORPHOLOGICAL SITUATIONS OF THE SMALL RIVER BASINS OF THE HAMAR-DABAN (ON THE EXAMPLE OF THE IRKUT RIVER TRIBUTARIES)**

**Abstract.** The article is devoted to the analysis of the ecological and geomorphological situations of small river basins of the Hamar-Daban ridge on the example of the Irkut river tributaries. Morphometric indicators were collected to characterize the features of the river basins relief using the digital elevation model ALOS. The Landsat satellite images were analyzed at different times. Field studies made it possible to supplement information on developed unfavorable and dangerous geomorphological processes, as a result of which fluvial, cryogenic, cryogenic-slope and erosion-slope processes were revealed in the studied territory of the basins.

**Keywords:** small river basins, morphometric analysis, Khamar-Daban, digital elevation model, ecological and geomorphological settings.

Ecological and geomorphological conditions characterize the relief features and relief-forming processes that directly or indirectly affect conditions of human life and natural environment components. Currently, small river basins of the northern macroslope of the Hamar-Daban ridge are poorly studied and are increasingly under anthropogenic pressure. It is necessary to consider the interaction of the relief with natural components and determine the impact on human activities for his life support.

Research purpose is an assessment of ecological and geomorphological conditions of small river basins of the Hamar-Daban ridge on the example of the Irkut river tributaries.

Research problem (задачи): Conduct analysis of field data for 2019-2020 years, analysis of multi-temporal satellite images of Landsat 7-8 in QGIS 3.4, assessment of morphometric parameters using the digital elevation model ALOS in the SAGA GIS 7.8 program.

In the research, the author used such research methods as descriptive, field, mathematical, cartographic, geomorphological; remote sensing of space images and geoinformation mapping were also applied.

Analysis of the digital elevation model showed that the absolute heights of small river basins vary from 655 to 2338 m; the average height is 1451 m and the standard deviation is 475 m. The middle mountains step (1300-1900 m) is distinguished in the elevation structure in terms of area, occupying about half of the studied territory (46.79%). This causes the spread of cryogenic and cryogenic-slope processes at this altitude. Cryogenic processes are represented by frost weathering and frost cracking in the subalpine and alpine zones, the formation of pingos on aligned groundwater-saturated surfaces. Cryogenic-slope processes are represented by viscoplastic soil flow on slopes with sparse forest vegetation (defluction). The main danger for anthropogenic and natural complexes is the disturbance of the integrity of their components.

The basic levels of the river network lie on the absolute heights of 855-900 m (22.6%), as well as the ranges of 900-1100, 1100-1300 and 1300-1500 m, each comprising 17% of the area which belongs to middle mountains. This is the evidence of ancient peneplain steps preserved at this level. The main areas of agricultural land are located at the heights of up to 900 m, as well as various infrastructure facilities (communications, federal highway A-333, buildings). Here, slope water-erosion processes are represented by sheet, rill and gully erosion and developed on non-forested surfaces. There are gullies of up to 20-25 m long and up to 4-6 m wide in the area of Zaktui, Kyren, Tory and Mondy villages. The formed gully network supplies loose sediments to the studied small river basins and in some places gullies are used for discharging domestic water and as dumps, which has an extremely negative effect on the ecological balance of the territory. In addition, gully formation causes damage to agriculture, reducing arable areas.

The steepness and exposure of slopes determine catchment intensity. Most slopes belong to the ranges of 0–5° (17.2% - very gentle) and 5–9° (16.3% - medium steepness) with an average value of 15.1°. Steep slopes (15–35°) account

for 42.4% of the study area. Such slopes presuppose widespread gravity-slope processes (talus, avalanches, etc.), and also contribute to the redistribution of temporary and permanent streams. Gravity-slope processes are distributed far from anthropogenic complexes, manifesting themselves only in the transformation of natural components.

Erosion processes were additionally assessed, using the indicators of the index of Length Steepness factor (LS-factor) and the Topographic Wetness Index (TWI). The LS-factor takes into account the slopes of the earth's surface and the area of the drainage basin. The higher the LSF value, the greater the ability of the water flow to cause erosion, which is important for agricultural plots near settlements in terms of assessment of the basin erosion network, land use, protection of land and water objects. The average LS-factor is 5.55 (high category) for the studied small river basins. More than 74.9% of the basin's territory belongs to high LS-factor indicators (more than 1.5), where the maxima are confined to the steepest slopes of the Hamar-Daban ridge.

The Topographic Wetness Index (TWI) indicates the potential moisture content of the catchment area. High index values indicate areas of moisture accumulation in soil, which makes it easier to identify erosion-slope and fluvial processes. The TWI values are categorized as follows: low (up to 4.6) - 1.7%, medium (4.8-7.6) - 67.1%, high (over 7.6) - 31%. The average TWI is 7.65. The most humid areas are confined to the channels of temporary and permanent streams, a sloping foothill plain in the eastern part of the study area, and flat surfaces of the middle mountains in the western part of the Hamar-Daban ridge.

All the previously considered morphometric parameters directly affect the development of fluvial processes, linearly developed within the channels of small rivers. These are processes of bed erosion, enhanced by tectonic processes; lateral erosion at the outlet of small rivers causing collapse of the banks. The series of landslide blocks are observed along the banks of the Haragun, Haribyaty and Kyren rivers especially within the settlements of Kyren, Haribyaty, Zhemchug and Tibelti. The negative impact of this ecological and geomorphological situation is manifested in the form of destruction of banks on the economic areas, dirt and forest roads, as well as siltation and damming of small river channels.

The leading role in the transformation of the studied basins relief belongs to fluvial, cryogenic-slope, cryogenic and erosion-slope processes. Natural and anthropogenic complexes are disturbed by erosion processes (gully, rill erosion) on non-forested and converted in the course of economic activity areas (villages Kyren, Zhemchug, Zaktui, Torah), defluction on the steep slopes of the Hamar-

Daban ridge, lateral erosion and destruction of river banks (rivers Turan, Kyren, Zaktui, Haragun, Tibelti and etc.), waterlogging (villages of Turan, Haribaty). The analysis of the ecological and geomorphological settings of the small river basins of the Hamar-Daban ridge showed that the territory is experiencing medium-intensity unfavorable and dangerous geomorphological processes, where special attention should be paid to fluvial and erosion-slope processes.

### References:

1. Bezgodova O.V. Natural and anthropogenic factors in the formation of small river channels of the Tunka depression (Republic of Buryatia) / O.V. Bezgodova // *Geosphere research*. – 2019. –N. 4. – P. 6–14. DOI: 10.17223/25421379/13/1
2. Bezgodova O.V. Ecological and geomorphological settings of the Kyngarga river basin (Republic of Buryatia) / O.V. Bezgodova // *Actual problems of nature management and environmental engineering*. – 2019. – P. 59–61.
3. Lamakin V.V. Neotectonics of the Baikal Depression / V.V. Lamakin // *Science*. – 1968. – P. 222.
4. Cushman S.A. (2008) Parsimony in landscape metrics: Strength, universality, and consistency / S.A. Cushman, K. McGarigal, M.C. Neel // *Ecological Indicators*. – V. 8. – P. 691–703.

*Scientific Supervisor:*

*Marina Y. Opekunova*

Ph. D. (Geography), Sochava Institute  
of Geography, SB RAS, Irkutsk.

УДК 314.746

**Andrej A. Voloshin**

*Laboratory of Geo-Resource Studies and Political Geography, V. B. Sochava  
Institute of Geography of the Siberian Branch of the Russian Academy of Sciences*

## **CHINESE MIGRANTS IN THE CONSTRUCTION BUSINESS OF THE IRKUTSK REGION: FORMAL AND INFORMAL ORGANIZATION OF WORK**

**Abstract.** The article is devoted to Chinese labor migrants in the construction sector of the Irkutsk region. The main purpose of the article is to show how and in what ways the mechanism of recruiting workers for construction sites functions; who and for what reasons comes to work in Irkutsk. The article includes a detailed consideration of two construction projects. One of the

largest construction companies of Irkutsk was chosen as the first object of research. This is a dynamically developing company with extensive experience in attracting foreign labor. The task of the second example (case study) is to show how different approaches are taken when choosing ways of recruiting workers. The material for the study was a series of interviews by the author and his personal observations, supplemented by Internet materials.

**Keywords:** Chinese migrants, China, labour migration, recruiting, Irkutsk region,

The most important characteristic of the current stage of Russia's economic and social development is the massive use of foreign labour force. In order to have a real understanding of the impact of this factor on the labour market, on socio-economic relations in general, it is necessary not only to know the quantitative parameters of the phenomenon or a sectoral structure, intensity and direction of cross-border labour migration flows, but also to identify hiring mechanisms and practices, as well as management of foreign labour.

The main objective of this study is to show, in two separate examples (cases), how the recruitment of Chinese workers at the Irkutsk construction sites takes place, who comes there and for what reasons, how the order of their stay and work is organized.

Research problems can be described in this way: very different options have been selected – from a large construction organization that has extensive experience in the use of foreign labour and tries to work in the legal field, to a situation of an informal and, in fact, illegal organization of labour.

A situation in the construction industry is of particular importance in this context. Following the trade and service sector, it is the main consumer of the labour of foreign migrants. The degree of dependence of the industry on this factor is enormous – no one has conducted relevant research; more or less reasoned expert assessments, both in the country as a whole and in individual regions, are extremely rare or even absent, but even the most superficial view of the problem shows that if the industry suddenly loses all the guest workers, it will experience deep crises, if not collapse.

#### Case 1: legal option

One of the largest construction firms in Irkutsk, VostSibStroy, was chosen as the first object of research. It is a dynamically developing enterprise that has a great experience in attracting foreign labour. The mechanism for hiring workers is organized as follows. The company undertakes all costs and efforts for the preparation of documents for each employee. Since the company operates in a legal field, the possibility of deception in this case is excluded. The procedure for registration of the brigade of workers at the construction site takes up to 6 months. The search system is fairly transparent. The company cooperates with a foreman

from China – an experienced worker who has been working in Russia for several years and has a fairly good command of spoken English. The foreman examines the design and estimates documentation of the construction object (drawings, calculations, etc.). Then he selects workers in China, considering the complexity of the construction site. The standard team includes the following professions: a carpenter, a concrete worker, a bricklayer, a plaster-painter, a fitter. The main requirement for workers is professionalism. The foreman, while in Russia, collects documents for the entire group of workers. The foreman, a Russian-speaking person, often highly-educated, mediates between an employer and the whole brigade. Often, the functions of the foreman are not related to construction; he is not a master who performs any work, but only a coordinator and organizer. Unlike a foreign team of builders with a Russian leader, the group of workers with a national team leader is more stable, with low probability of conflicts. The foreman with the same nationality takes better care of his compatriots, and it is usually easier to manage a team of builders of this type.

#### Case 2: shady scheme

The second object of study was one of the households, where the Chinese citizens work. In May 2017, I was able to visit such a private construction site in one of the satellite cities of Irkutsk and interview a Chinese group of workers who carried out internal and external work, installed communications. In the first case, we see that the firm is interested in ensuring that its employees are employed in accordance with all the requirements and have work permits. The second example looks diametrically opposite and, here, risks are worth mentioning. The so-called ‘employment’ in this case is implemented according to shady schemes. As the foreman explained, a group of Chinese citizens come to Russia under the guise of a tourist visit. The term of a tourist visa is 30 days, and at the time of the study, visas for the entire group were overdue. In fact, it is very easy to get visas; it is enough to provide data from a travel agency that invites the Chinese here. But it does not give the right to work. The foreman himself had lived and worked in Russia for 7 years with short breaks. The hiring procedure was as follows: the foreman, who lives continuously in Russia, goes to China, where he invites those interested to work in Russia. He does not have a permanent team of workers, but he has many acquaintances who have experience in construction. The employer gives money for transfer and food. There are no documents regulating labour relations. Also there is no package of social guarantees. All of the above actually means that the Chinese have complete legal powerlessness. Salary is not regulated; it all depends on the amount and quality of work. The money is transferred to the foreman who divides

salary between the workers. Thus, the risks of non-payment (full or partial) of salary increase. There is nothing more, but the oral agreement between the team and the employer. The employer does not bear any responsibility for the workers. Honesty and decency of the employer and the foreman play the greatest role here.

Of course, the two cases do not claim to be a complete analysis of the situation. But they were selected in such a way as to show its certain points. On the one hand, it is a large construction company interested in a stable use of foreign labour for many years and having extensive experience in this area, qualified managers and well established forms of work. The company is committed to the greatest possible legality and transparency; it has the ability to spend significant funds and efforts to complete all the necessary formalities, to pay an officially declared salary with the necessary deductions. Cheap labour of illegal, unregistered migrants is unprofitable and fraught with difficulties with the law enforcement agencies. Large developers are trying to protect themselves from unwanted raids of the FMS and other structures by using and improving the system of selection of qualified personnel; they are interested in the transparency of their chosen practices. Although the format of the legal field also has some loopholes aimed at circumventing problematic aspects. On the other hand, there are cases representing completely informal relations. They are temporary seasonal work, the absence of any fixed contractual relations, workers who entered on tourist visas without the right to work, and tax evasion. In other words, these are cases of complete social insecurity and violations of migrant workers' rights. In both cases, the figure of the foreman comes to the fore, playing a key role in the relationship between employers and employees. He is not so much the organizer of the work as an intermediary.

### **References:**

1. Consideration of the problems of management organization in the context of the changing nature of labour migration [Electronic resource] (2017). In the 4th report of the International Labour Office. Geneva: International Labour Conference. 106th session. 87 p. Available at: [http://www.ilo.org/wcmsp5/groups/public/---ed\\_norm/---relconf/documents/meetingdocument/wcms\\_550536.pdf](http://www.ilo.org/wcmsp5/groups/public/---ed_norm/---relconf/documents/meetingdocument/wcms_550536.pdf) (Accessed 21 May 2020).
2. On the legal status of foreign citizens in the Russian Federation [Electronic resource]: Federal Law of July 25, 2002 No. 115-Φ3 (as amended on April 17, 2020). Accessed from the computer-based legal research system

“ConsultantPlus” in the local network of the Scientific Library of the Irkutsk State University

3. Larin, A. (2008). Chinese migrants in the eyes of Russians [Electronic resource]. In Demoscope Weekly. (333–334), 19 May – 1 June 2008. Available at: [http://demoscope.ru/weekly/2008/0333/tema01.php#\\_FNR\\_](http://demoscope.ru/weekly/2008/0333/tema01.php#_FNR_) (accessed 20 May 2020).

*Scientific supervisor:*

*Victor I. Dyatlov*

Doctor of Science (History), Professor

УДК 533.951

**Aleksandr V. Rubtsov<sup>1,2</sup>, O.S. Mikhailova<sup>1</sup>, D.Yu. Klimushkin<sup>1</sup>, J. Ren<sup>3</sup>, Q.-G. Zong<sup>3</sup>**

*1 - Institute of Solar-Terrestrial Physics SB RAS, Irkutsk*

*2 - Applied Physics Institute, Irkutsk State University, Irkutsk*

*3 - Institute of Space Physics & Applied Technology, Peking University, Beijing*

## **PRE-SUBSTORM ULF WAVES OBSERVED BY MULTIPLE SPACECRAFTS**

**Abstract.** We found unique pre-substorm ULF waves in the magnetosphere using multiple spacecrafts data. The observation lasted for ~15 hours in a wide range of radial and azimuthal distances. The generation mechanism for observed waves to be determined in further study.

**Keywords:** УНЧ волны, суббуря, магнитосфера, ULF waves, Substorm, Magnetosphere.

Ultra-low frequency (ULF) waves are often observed in the magnetosphere by spacecrafts and radars [1]. Usually, it is a poloidal mode with a high azimuthal wavenumber  $m$ . Some authors reported observation of such waves in large azimuthal sectors, at radial distances from 4  $R_E$  up to 10  $R_E$ , and lasted for a few days [2]. The most important questions within these waves are their generation mechanism and wave-particle interactions during the observation. Most of the studies conclude that ULF wave generation relates to the substorm injections, but direct excitation from the solar wind through the magnetopause is also possible [3, 4]. Observed ULF waves have different theoretical explanations. It could be an Alfvén wave from magnetohydrodynamic [5] or a drift-compressional wave in terms of kinetic theory [6].

We present a preliminary analysis of the observation of the poloidal wave on the dayside of the terrestrial magnetosphere. Its frequency depends on the distance from the Earth and falls into the Pc4-5 band (45–600 s period). This wave was observed for ~15 hours by widely spaced satellites of three missions: Van Allen Probes, Time History of Events and Macroscale Interactions during Substorm (THEMIS), and Geostationary Operational Environmental Satellites (GOES). It covers MLTs from 7 to 17 hours and  $L$ -shells from 4.5 to 8  $R_E$ . The substorm injection on the nightside observed by GOES15 was 20 minutes after the wave appearance. The AE index started to increase ~10 minutes later. Thus, the first observation of the wave was ~30 minutes before the substorm. Note that the solar wind conditions were quiet, and there were no magnetic storm or substorm activities within at least 12 hours before. At this point, we cannot identify the waves' source. Probably, it could be a gradient instability [7].

The combined spacecrafts observations demonstrate discrete frequency dependence on  $L$ -shell. The measurements at the same  $L$ -shell at different times show a sharp frequency increase with time. Some oscillations were observed in the energy range 30–500 keV in both ion and electron flux data, but it didn't cover the whole interval under consideration. Interesting that only electron flux oscillations correspond to observed waves for  $L > 6 R_E$  according to THEMIS and GOES measurements. But Van Allen Probes shows a short interval of ion flux oscillation with the wave. We'll study this effect. The azimuthal wave number was preliminary calculated using the finite gyroradius effect and equals  $-(20-80)$ , so the observed waves are high- $m$  ones.

The reported study was funded by RFBR and NSFC according to the research project 20-55-53009.

### References:

- [1] Shi X. Long-lasting Poloidal ULF Waves Observed by Multiple Satellites and High-Latitude SuperDARN Radars / X. Shi [et al.] // Journal of Geophysical Research: Space Physics. – 2018. – V. 123, N. 10. – P. 8422-8438.
- [2] Le G. Global observations of magnetospheric high- $m$  poloidal waves during the 22 June 2015 magnetic storm / G. Le [et al.] // Geophysical Research Letters. – 2017. – V. 44. – P. 3456-3464.
- [3] Ren J. A Comparative Study of ULF Waves' Role in the Dynamics of Charged Particles in the Plasmasphere: Van Allen Probes Observation / J. Ren [et al.] // Journal of Geophysical Research: Space Physics. – 2018. – V. 123, N. 7. – P. 5334-5343.

- [4] Wang B. Global Propagation of Magnetospheric Pc5 ULF Waves Driven by Foreshock Transients / B. Wang [et al.] // *Journal of Geophysical Research: Space Physics*. – 2020. – V. 125, N. 11. – e2020JA028411.
- [5] Zolotukhina N.A. Pc5 waves generated by substorm injection: a case study / N.A. Zolotukhina, P.N. Mager, D.Yu. Klimushkin // *Annales Geophysicae*. – 2008. – V. 26. – P. 2053-2059.
- [6] Rubtsov A.V. Drift Resonance of Compressional ULF Waves and Substorm-Injected Protons From Multipoint THEMIS Measurements / A.V. Rubtsov [et al.] // *Journal of Geophysical Research: Space Physics*. – 2018. – V. 123, N. 11. – P. 9406-9419.
- [7] Yamamoto K. Eastward Propagating Second Harmonic Poloidal Waves Triggered by Temporary Outward Gradient of Proton Phase Space Density: Van Allen Probe A Observation / K. Yamamoto [et al.] // *Journal of Geophysical Research: Space Physics*. – 2019. – V. 124, N. 12. – P. 9904-9923.

УДК 551.521.3

**I.P. Yakovleva, M.A. Tashchilin**

*Institute of Solar-Terrestrial Physics SB RAS, Irkutsk*

## **AEROSOL OPTICAL DEPTH SPECTRAL CHARACTERISTICS UNDER EXPOSURE TO FOREST FIRE SMOKE IN THE BAIKAL REGION**

**Abstract.** In this work, the features of the aerosol optical depth (AOD) spectral characteristics under the forest fire smoke conditions are considered in comparison with the background conditions in the Baikal region. The results of expedition measurements in 2018-2020 were used applying a portable SPM photometer. For two types of conditions (background and forest fire smoke conditions), the AOD optical characteristics, fine and coarse AOD components, Angstrom parameters, and reconstructed parameters of the aerosol microstructure are presented.

**Keywords:** aerosol optical depth, AOD, smoke aerosol, microstructure parameters

The study of atmospheric radiation-significant components variations is one of the tasks in the context of the Earth's climate change problem. Atmospheric aerosol plays an important role in radiation processes, along with greenhouse gases and clouds. The main and best studied aerosol optical characteristic is the

atmospheric aerosol optical depth (AOD). Smoke from forest fires has a strong effect on the atmosphere radiation characteristics in summer, and is an important component of optical weather in a number of regions, including the Baikal region.

Solar photometry methods remain one of the most effective tools for obtaining information about aerosol parameters. In this work, data from two photometers were used to measure the atmospheric AOD: a mobile SPM photometer (developed by the V.E. Zuev IAO SB RAS) and a stationary CIMEL CE-318, which is part of the AERONET automated aerosol monitoring network (<https://aeronet.gsfc.nasa.gov>). CE-318 photometer is installed at the Geophysical Observatory (GO) of ISTP SB RAS near the Tory village (Tunka Valley, Buryatia).

Within the framework of this study, measurements of atmospheric aerosol characteristics were carried out in background conditions, as well as under forest fire exposure at the permanent observation point in the GO ISTP SB RAS in the Tory village (51.78° N, 103° E), and also in expeditionary conditions near the Sarma village (53.08° N, 106.83° E) and the Babushkin city (51.83° N, 106.06° E).

The AOD background characteristics were obtained in April 2018 and 2020, before the beginning of the fire season. The AOD characteristics for pyrogenic events were obtained in expeditionary conditions as a result of monitoring fire situations, smoke events near observation points based on available information sources (visual observations, satellite data for monitoring a fire hazard [1], media reports, etc.).

When comparing the results under forest fire smoke exposure and background conditions, the following AOD characteristics were used: the values of the spectral AOD  $\tau_{\lambda}^a$ , the moisture content of the atmosphere  $W$  (g/cm<sup>2</sup>), the Angstrom selectivity index  $\alpha$ , the turbidity coefficient  $\beta$ , the AOD contribution of coarse  $\tau^c$  and fine  $\tau_{0.5}^f$  aerosol obtained by the method described in [2].

The average spectral dependences of AOD at three observation points for background conditions, as well as for six cases of smoke aerosol, are shown in Figure 1. As can be seen from the figure, expeditionary measurements were carried out both during moderate pyrogenic events, when the average AOD values in the short-wavelength region of the spectrum exceeded the background values by 2–3 times, and under extreme smoke situations, in which the values of  $\tau_{\lambda}^a$  exceeded the background ones by 6–8 times, moreover in most of the spectrum. For background conditions, characteristic hyperbolic spectral dependences  $\tau_{\lambda}^a$ , are observed, as well as for moderate turbidity, while under extreme pyrogenic events the dependence becomes closer to linear.

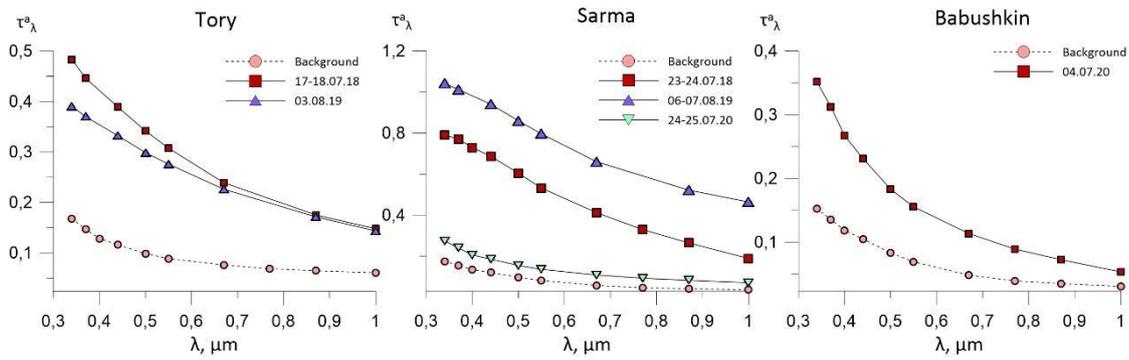


Figure 1. Average spectral dependences  $\tau_{\lambda}^a$  at three observation points in background conditions and in situations of forest fire smoke

As follows from Figure 1, the most significant changes in AOD under smoke conditions occur in the short-wavelength and visible parts of the spectrum due to higher values of the fine component  $\tau_{\lambda}^f$ .

With moderate pyrogenic events, the fine AOD component  $\tau_{0,5}^f$  increases, on average, 3-5 times, while the coarse component  $\tau^c$  practically does not change, which is a consequence of the predominance of small particles in the smoke aerosol composition. The selectivity of the spectral dependence  $\tau^a(\lambda)$  changes insignificantly, while the turbidity coefficient increases 3 times, i.e. an increase in the fine AOD component is caused not by a change in the particles size, but by their concentration increase.

For background conditions and forest fire smoke situations, in addition to optical characteristics, the change in the disperse composition of aerosol particles was assessed using the method described in [3]. The following parameters of the aerosol microstructure were considered: the volume filling factor  $V$  ( $\text{cm}^3/\text{m}^2$ ), which determines the volume of aerosol particles in the atmospheric column with a single base, the average particle radius  $\langle r \rangle$  ( $\mu\text{m}$ ), defined as the ratio of the volume filling factor to the particles total geometric section.

It was found that under conditions of moderate pyrogenic activity compared to background conditions, the volume filling factors for a submicron aerosol increase by an average of 3 times, for a coarse aerosol by 1.5 times. During extreme events, the increase in the volume factor of the submicron aerosol reaches 5 times, and for coarse aerosol is one order of magnitude. In this case, the average  $\langle r_1 \rangle$  radii during pyrogenic events increase, on average, by 20%, while the  $\langle r_2 \rangle$  values change upward and downward, depending on pyrogenic events, but these changes are insignificant.

**Acknowledgements.** The work was financially supported by the Ministry of Science and Higher Education of the Russian Federation. The results were

obtained using the equipment of Shared Equipment Center “Angara” <http://ckp-rf.ru/ckp/3056/>.

### References:

1. Web site: <http://gis.iszf.irk.ru/>
2. Sakerin SM, Kabanov DM On the relationship between the parameters of the Angstrom formula and the aerosol optical depth of the atmosphere in the spectral range of 1-4 microns. // Optics of the atmosphere and ocean. 2007. T. 20. No. 03. S. 222-228.
3. Sviridenkov MA Determination of characteristics of atmospheric aerosol from spectral measurements of transparency and small-angle scattering. // Optics of the atmosphere and ocean. 2001. T. 14.No. 12. S. 1115-1118.

УДК 551.594.21

**MOLCHANOVA N.O.<sup>1</sup>, POLETAEV A.S.<sup>2</sup>, VASILIEV R.V.<sup>1</sup>, CHENSKY A.G.<sup>2</sup>**

<sup>1</sup>*Institute of Solar-Terrestrial Physics SB RAS, Irkutsk, Russia*

<sup>2</sup>*Irkutsk National Research Technical Institute, Irkutsk, Russia*

*e-mail: nat.tali1996@iszf.irk.ru, sardaukar9@yandex.ru,*

*roman\_vasilyev@iszf.irk.ru, vavmts@istu.edu*

## **REVIEW OF ATMOSPHERIC EFFECTS ASSOCIATED WITH LIGHTNING DISCHARGES**

**Abstract.** This article provides a brief overview of the nature of thunderstorm activity, and describes the basic characteristics of electromagnetic signals from lightning strikes recorded in the center of Eurasia. The scheme of the hardware complex for recording radio signals from lightning is presented. The KiwiSDR board with a built-in BeagleBone single-board computer is offered as a receiver for recording and processing the electromagnetic pulse coming from a lightning discharge. This device operates in a wide frequency range from 1 kHz to 30 MHz, which allows it to receive signals from inter-cloud, intra-cloud, descending and ascending lightning.

**Keywords:** lightning discharges, spheres, atmospheric, tweaks.

One of the main sources of electromagnetic radiation of natural origin is lightning discharges. The energy of this source is distributed in a relatively wide frequency band, but the main share of energy falls on frequencies below 100 kHz with a maximum of radiation in the region of 1-10 kHz. For ordinary linear (descending) lightning, the main observational problem is the unpredictability of its time of occurrence and its location, but the great advantage is that they are visible globally [1], including by satellite means. Discharges in the upper atmosphere, such as sprites, can be registered at a distance of hundreds of

kilometers from their origin, and also from space, such lightning is called ascending.

Electromagnetic signals from lightning discharges, depending on the path of their propagation, are divided into pulses that are associated with propagation along the Earth's surface: (spheres, atmospherics, tweaks) or along the lines of the Earth's magnetic field in the magnetosphere (whistles, whistlers), which are described by an unusual wave [2]. The characteristic frequency band of these electromagnetic signals is approximately 100 Hz to 8 kHz.

- Globally, the maximum concentration points of both linear and high-altitude lightning [3] are located along the equator line. In the center of Eurasia, both local lightning and lightning that occurs on the equator with the help of spheres can be registered. By determining the time of registration of the sphere at various reception points, you can determine the location of a lightning strike, solving the direction finding problem. Whistlers are signals from local lightning or lightning occurring at a magnetically coupled point, these signals have long (second) delays after the main lightning discharge, direction finding of these signals is also possible, although it is associated with some technical difficulties.

- Thunderstorms have a daily-seasonal trend. The frequency of lightning is less in the morning than in the evening, because thunderclouds are formed as a result of the rise of moist air, which occurs mainly in the second half of the day over the Sun-warmed surface of the Earth. As a rule, lightning is concentrated in the summer months (April-September) and only a meager 1-2% of strikes occur in the winter half-year (October-March). Winter lightning has a higher percentage of positive cloud-to-ground lightning strikes (+CG) than summer lightning. During winter thunderstorms, the cloud height is generally lower than in summer, due to weaker convection. Often, a strong wind blows at the height of the storm clouds, and not at ground level. This wind shear tends to shift the upper, positively charged part of the cloud ahead of the lower, negatively charged parts. The positive charge is then only weakly shielded from the ground or not shielded at all, and positive +CG strikes become possible (this explanation cannot be used to explain all positive lightning in winter, there are other reasons).

The sprite is usually associated with positive descending strong lightning. Therefore, in the center of Eurasia, less frequent high-altitude lightning discharges can be expected, since mid-latitude continental thunderstorms are much weaker than equatorial thunderstorms. We estimate the height of the electric breakdown for the formation of high-altitude lightning. The change in the atmospheric electric

field strength of the air breakdown with altitude can be estimated using the formula from [4]:

$$E = \delta_0 \frac{q}{\delta_0}, \quad (1)$$

where  $\delta_0$  - is the density of air at sea level under standard atmospheric conditions ( $2.7 \cdot 10^{25}$  molecules/m<sup>3</sup>), and  $q_0$  - is the corresponding critical electric field required for electrical breakdown under the same conditions ( $2.8 \cdot 10^6$  V/m).

The electric field strength of the cloud - earth dipole depending on the height of the atmosphere (calculated in different ways)

$$E = \frac{-q}{4\pi\epsilon_0 r^2} + \frac{q}{4\pi\epsilon_0 (r+h)^2}, \quad (2)$$

where  $r$  - is the height of the atmosphere,  $h$  - is the height of the cloud,  $\pm q$  - is the charges of the cloud-earth electric dipole, and  $\epsilon$  is the permittivity of the atmosphere.

$$U = \frac{-q}{4\pi\epsilon_0 r} + \frac{q}{4\pi\epsilon_0 (r+h)}, \quad (3)$$

$$E = -\frac{dU}{dr}, \quad (4)$$

where  $U$  is the potential of the cloud-earth dipole,  $dU/dr$  is the potential gradient, that is, the ratio of the voltage to the distance between the potentials.

The electric field of the dipole in the atmospheric air must increase beyond the critical value obtained in formula (1) in order for an electric breakdown to occur in the upper atmosphere, which characterizes the formation of high-altitude lightning. According to these formulas, graphs of the dependence of the tension on the height are constructed (Figure 1).

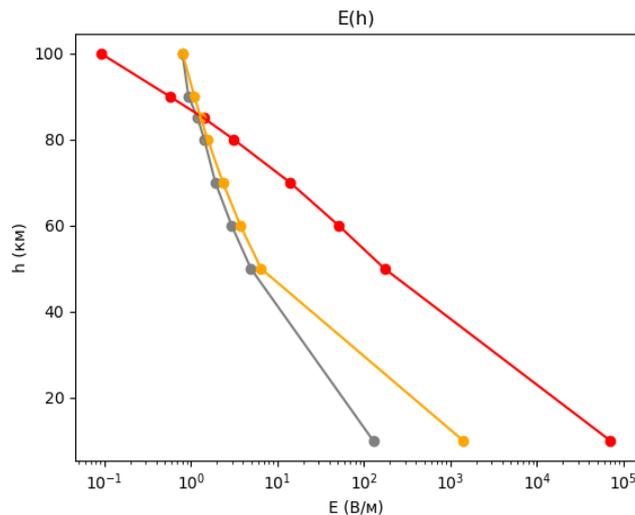


Figure 1. Red line - atmospheric field strength, plotted according to formula (1), orange line - cloud - earth dipole field strength, according to formula (2), gray line - cloud - earth dipole field strength, according to formula (4).

The height of the critical value is approximately 85 km (the point where the lines intersect).

Monitoring of thunderstorm activity is important for timely protection against damage to power lines using lightning rods, for the safety of air travel, navigation of ships, as well as for new research opportunities in such areas as meteorology, hydrology, geology, etc. [5]. The use and development of a network of lightning direction-finding stations will be of particular interest for solving practical problems of monitoring and preventing dangerous phenomena associated with intense precipitation and atmospheric electricity discharges.

The block diagram of such a lightning direction finding device is shown in Figure 2.

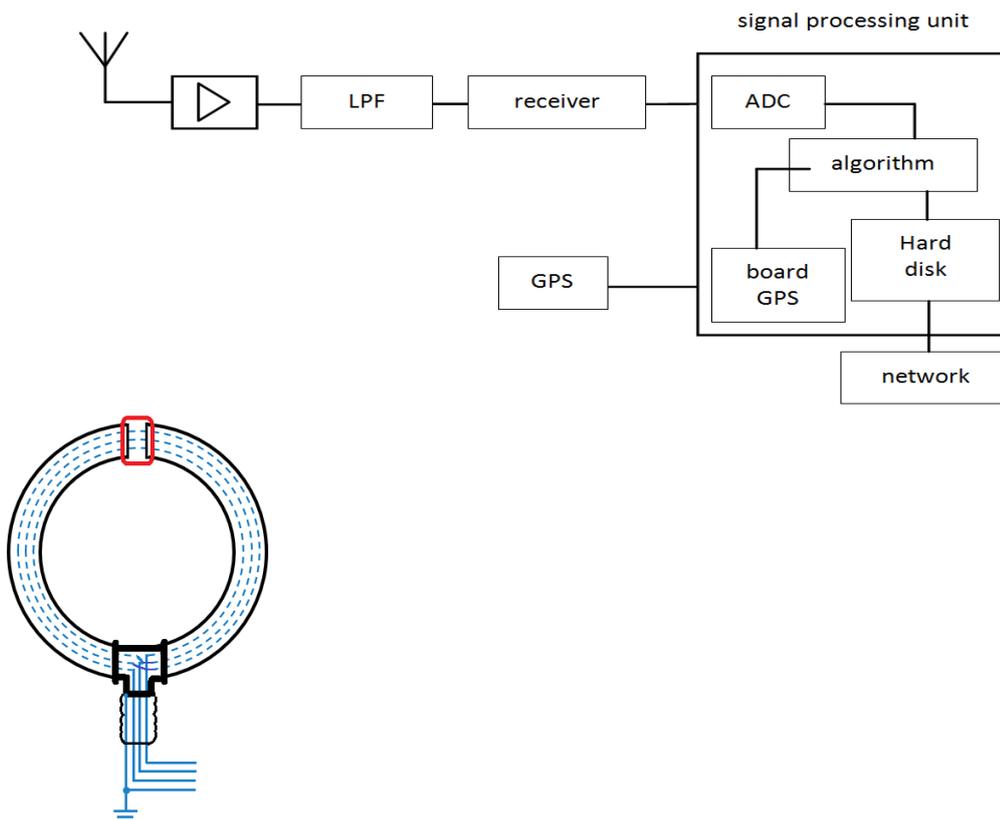


Figure 2. Block diagram of the receiver of a single-point network for recording lightning discharges. The design of the receiving antenna of the layout of the lightning direction finding network recorder. 1 - the beginning of the winding; 2-the middle point; 3-the end of the winding; 4-ground; 5-screen; 6-dielectric coupling; 7-seat; 8-metal sleeve

The antenna continuously registers the vertical electric field (waveforms) propagating in the waveguide of the earth's ionosphere. The signals are pre-amplified and noise is minimized using a preamp and are marked with GPS time (1 microsecond accuracy) and then encoded in an analog-to-digital converter [6].

The amplifier is made on the ultra-low-noise chip KR538UN3A, designed for low-resistance inductive sensors. The noise level of the chip is about  $2 \text{ nV}/\sqrt{\text{Hz}}$ , which is a good indicator compared to other chips.

The voltage gain is regulated by a tuning resistor and can be set in the range from 46 to 53 dB. The unevenness of the frequency response (amplitude-frequency response) in the 500 Hz to 50 kHz band is not more than 1 dB. The power consumption of the amplifiers is 70 MW (12 V, 5.84 mA).

To protect the equipment from strong pulsed electromagnetic interference, a lightning protection scheme is provided on the gas discharge device.

From the point of view of technical implementation, to simplify the task, a KiwiSDR board was used as a digital receiver (a broadband SDR of 1kHz-30MHz and an integrated BeagleBone single-board computer). The receiver board has open source software - the GPS receiver project. BeagleBone has a running web

server that allows you to listen to the received data from the antenna in the browser.

In the system, the lightning direction finder can be connected to the analysis of global data obtained with the help of sensors located on satellites that have a polar orbit. Such satellites are much higher than thunderstorms. Also, the inclusion of an IR spectrometer in this system will allow us to study the transient optical phenomena in the upper atmosphere (between the thundercloud and the ionosphere), the properties of electric discharges and their interactions with the fluxes of neutral and charged particles.

### References:

1. Herbert Boerner *Ball Lightning // A Popular Guide to a Longstanding Mystery in Atmospheric Electricity*, Springer Nature Switzerland AG 2019
2. Блюх П. Свист в космосе // Научно-популярный физико-математический журнал "Квант", №3, 1997.
3. Williams E. R., Lyons W. A. Ground-based detection of sprites and their parent lightning flashes over Africa during the 2006 AMMA campaign - <https://www.researchgate.net>
4. Cooray V. *An Introduction to Lightning // Springer, Heidelberg 2015*
5. Панюков Б.Д., Будувев Д.В. Системы пассивного мониторинга грозовой деятельности // Вестник ЮУрГУ, №8, 2003.
6. Maxwell E.L., Stone D.L. Natural Noise Fields 1cpsto 100kc // IEEE Transactions on Antenna and Propagation. – 1963. – Vol. AP11. – №3. – pp. 339-343; Chrissan D.A., Fraser-Smith A.C. Seasonal Variations of Globally Measured ELF/VLF Radio Noise // Radio Science. – September 1996. – Vol. 31(5). – pp. 1141-1152.

УДК 550.338.2

**A.A. Rybkina, V.I. Kurkin, V.A. Ivanova**

*Institute of solar-terrestrial physics, SB RAS, Irkutsk*

## **DIAGNOSTICS AND INVESTIGATION OF THE MORPHOLOGICAL CHARACTERISTICS OF TRAVELLING IONOSPHERIC DISTURBANCES BASED ON THE DATA OF NEAR-VERTICAL AND VERTICAL SOUNDING OF THE IONOSPHERE IN DECEMBER 2012 – JANUARY 2013**

**Abstract.** In this paper, we carried out a morphological analysis of traveling ionospheric disturbances during the strong sudden stratospheric warming in December 2012 – January 2013 over Eastern Siberia. As a result of semiautomatic processing of near-vertical and vertical ionograms, we were successful in detecting irregularities and indicating their particular features.

**Keywords:** перемещающиеся ионосферные возмущения, серп, ионосфера, вертикальное и слабонаклонное зондирование; traveling ionospheric disturbances, cusp, ionosphere, near-vertical and vertical sounding.

An occurrence of traveling ionospheric disturbances (TIDs) in the ionosphere was detected by Australian scientists back in the 1950s [1-4]. At the time, a usable hardware and software complex did not allow us to carry through comprehensive processing of irregularities. Further development of the ionosphere radio sounding technique and upgrade of facilities made it possible to investigate TIDs morphological features. In this connection, authors [5] represented cusp-shaped irregularities classification and investigated their morphology.

In the course of our investigation, we carried out a statistical analysis of near-vertical and vertical ionograms from December 24, 2012 to January 31, 2013 on the Usolye-Sibirskoe – Tory and Tory – Tory radio paths, respectively. The time interval was not chosen by chance, since the sudden stratospheric warming was observed during that period over the region of Eastern Siberia of the Russian Federation. The minute interval in the ionosphere sounding made it possible to obtain sufficient statistical material for diagnostics of irregularities.

Using the ionogram semiautomatic processing we investigated TID frequency response characteristics, time of occurrence, and existence interval.

We have identified four types of cusps. The average interval of irregularity appearance fell on the time from 23:00 UT to 12:00 UT with a maximum at 02:00–10:00 UT during the day. At the same time, TIDs were not always observed on two radio paths simultaneously and related to different types. The average existence interval for the first type was 9 min, the second – 7 min, the third – 14 min, the fourth type was observed only on the Usolye – Tory radio path on December 24, 2012 at 08:48 UT and January 1, 2013 at 09:21 UT.

We determined particular features: a cusp appeared from the left of foF2 (it is typical for all types); could be present on the part of foF2 and absent from fxF2 (this feature was more common on the vertical sounding path Tory – Tory); TIDs of the third type descended on the right-hand side of foF2, and ascended on the left.

The authors pointed out that the first type TIDs prevailed over others in event frequency [5]. But we found that on some days, their quantity was less compared with other types. In addition, the total amount of cusps was changed in

the considered time interval. On the days when the maximum quantity of irregularities was observed, TIDs had a complex character and were pronounced.

Acknowledgements. The work was financially supported by the Ministry of Science and Higher Education of the Russian Federation. The results were obtained using the equipment of Shared Equipment Center “Angara” <http://ckp-rf.ru/ckp/3056/>.

#### **References:**

1. Munro G.H. Travelling ionospheric disturbances in the F region // Austral. J. Phys. 1958. V. 11, N 1. P. 91–112.

2. Munro G.H. Travelling disturbances in the ionosphere // Proc. Roy. Soc. Lond. A. 1950. V. 202, N 2. P. 208–223.

3. Heisler L.H. Anomalies in ionozonde records due to travelling ionospheric disturbances // Austral. J. Phys. 1958. V. 11, N 1. P. 79–90.

4. Munro G.H., Heisler L.H. Cusp type anomalies in variable frequency ionospheric records // Austral. J. Phys. 1956. V. 9, N 3. P. 343–358.

5. Kurkin V.I., Laryunin O.A., Podlesnyi A.V., Pezhemskaya M.D., Chistyakova L.V. The study of morphological characteristics of travelling ionospheric disturbances using quasi-vertical ionospheric sounding data // Atmospheric and Oceanic Optics. 2014. V. 24, N 2. P. 158–163.



## Linguistics and Educational Sciences

УДК 81

**Tatyana S. Paderina**

*Department of foreign languages and philosophy,  
Irkutsk Scientific Center, SB RAS, Irkutsk*

### **ABOUT THE QUESTION OF ETHNOCULTURAL STEREOTYPES IN THE LINGUISTIC CONSCIOUSNESS OF RUSSIANS AND GERMAN**

**Abstract.** The phenomenon of stereotyping manifests itself in various spheres of human life and receives a certain interpretation in different fields of knowledge. In this article we consider the issue of verbalization of ethnic stereotypes in the linguistic consciousness of Russians and Germans.

**Keywords:** stereotype, ethnocultural, stereotypes, communication, cross-cultural communication, ethnic stereotype, linguistic consciousness, stereotyping.

In the era of global processes and intensive cross-cultural communication, the role of linguistic and cultural self-identification of the ethnic group is increasing.

To achieve an effective process of cross-cultural communication, it is necessary to overcome a number of difficulties related to the fact that representatives of different cultures perceive information differently. Meeting with representatives of other cultures, a person interprets the behavior of opponents from the point of view of his formed linguistic picture of the world, sometimes this leads to a misunderstanding of another language, facial expressions, gestures, etc.

The article is devoted to the study of ethnocultural stereotypes in the linguistic consciousness of speakers of Russian and German.

In our work, we consider ethnocultural stereotypes based on such concepts as stereotype, linguistic picture of the world, linguistic consciousness.

The works of such researchers as U. Lippman, E. Bartminsky, S.V. Gladkikh, I.A. Sternin, S.A. Arutyunov, L.P. Krysin and others are devoted to the problem of the formation and functioning of ethnic stereotypes in the language consciousness.

The purpose of the work is to study the verbalization of ethnocultural stereotypes and the definition of dominant stereotypes of the Russian and German.

To achieve this goal, the following tasks were identified:

- to define the concept of a stereotype and its features;
- to study the specifics of the perception of the surrounding reality by representatives of different cultures;
- to determine the features of the influence of national thinking in the process of stereotyping;
- to study the influence of stereotypes in building a constructive cross-cultural dialogue.

In the process of perception of objects of reality and their categorization, stereotypes are formed, including stereotypes both in relation to themselves, their ethnic group as a whole, and to representatives of other linguistic cultures. The first most definite use of the word “stereotype” as a scientific term was proposed by American publicist W. Lippman in the book "Public opinion" in 1922. The author considered the stereotype as “templates” or “schemes” that help to navigate in the surrounding reality and perform the functions of “economy of thinking” and psychological protection, maintaining the stability of the subjective picture of the individual's world. [The Big Russian Encyclopedia <https://bigenc.ru/philosophy/text/4165944>].

When studying the role of stereotypes in cross-cultural interaction, it should be taken into account that stereotypes reflect national characteristics. National (ethnic stereotypes), verbalized in sustainable terms, contain a rich linguistic and cultural resource and allow us to form ideas about the people, their national culture, traditions and customs. The view of the people is formed on the basis of information obtained in the process of communication or joint activities.

Ethnocultural stereotypes are divided into personal stereotypes (autostereotypes) that reflect the vision of their own image and culture of their people, and heterostereotypes that generalize views on other peoples and cultures.

The autostereotype is enhanced through the isolation mechanism from the “alien” group. So ethnocentrism is formed, which puts its own culture as a priority and evaluates other groups in opposition to it. Being a bearer of linguistic and cultural heritage, representatives of the ethnic group often become unable to

objectively assess the events and phenomena of another ethnic group (nation). In such situations, the stereotype allows you to draw a dividing line between “own” and “aliens”.

Analysis of literature on research in the field of stereotypes reveals a variety of objects of this category: cliches, language stereotypes, speech stereotypes, standard replicas, phraseologisms, proverbs, winged expressions, business standards, quotes, aphorisms, etc. Thus, the linguistic concept of stereotype covers a rather wide range of phenomena.

Based on historical experience and examples from the national corps of the Russian language, we identified the following stereotypes about Russians and Germans.

The Russian people are characterized by such features as patriotism, courage and fortitude. In Russian proverbs, for example, they often praise the heroism and fearlessness of the people:

- Knows the whole world - there are no *harder Russians*.<sup>[1]</sup>

- *The Russian* soldier does not know the obstacles.

- As N. S. Leskov, the husband of his aunt, the Englishman A. Ya. Shkott, recalled, when he was told the plot of “Dead Souls”, he concluded that *the Russian people could not be defeated* [Maxim Sokolov].

- But *the Russian people* gradually became noticeable and pleasant to him - this people who had never betrayed on him, starved for as many years as it was necessary, calmly went to war, even to camps, to any difficulties and never rebelled. [Alexander Solzhenitsyn].

- *Great and powerful Russian people/people* of Razin and Lomonosov/Pushkin and Herzen/Gorky and Lenin!

- But *the Great Russian people* live and will live.

The basic characteristics of the German people certainly include thrift and economy. The German people are characterized by a synthetic attitude of mind, a manifestation of patience, a conscientious attitude to work:

- *Geduld uderwindet alles* (patience conquers all).

- *Proud and beautiful, for the German people* are superior to all other peoples, they are the most valuable of all the peoples of the Earth [Daniil Granin].

- And I appreciate the German people for the basic character trait, for the pathos of labor, for the irresistible passion for improving their home on the land of their country; and I love the German intelligentsia for its agitated Faustian soul [R. B. Gul].

- And therefore, it must be argued with no doubt that it is not Hitler alone who is to blame for it, but the entire German people, a material people, proud and cruel, cold, like all pirates and robbers. [Metropolitan Benjamin (Fedchenkov)].

The culture, worldview and life foundations of the people are reflected in the choice of linguistic means to indicate objects and phenomena of the surrounding reality. The stereotype is inextricably linked to national culture and is an integral part of the conceptual picture of the world. The use of stereotypes is automatic, even if it contradicts the empirical picture of the world, but it should also be remembered about the dualism of stereotypes, which can both distort reality and simplify the process of assimilation of information.

Issues related to mechanisms and factors affecting stereotyping require deep and systematic study.

*Scientific supervisor:*  
*Nataliya A. Sverdlova,*  
Ph.D. (Philology), Associate professor,  
Irkutsk Scientific Center, SB RAS, Irkutsk

---

[1] here and further the author's translation

УДК 81-26

**Bo Xue**

*Department of foreign languages and philosophy,  
Irkutsk Scientific Center, SB RAS, Irkutsk*

## **ABOUT AUTOSTEREOTYPES IN NONVERBAL COMMUNICATION OF RUSSIANS AND CHINESE**

**Abstract.** The author proposes to consider some examples of non-verbal communication between the Chinese and Russians, which reflect the stereotypical vision of the representatives of nations about themselves.

**Keywords:** stereotype, autostereotype, nonverbal communication, cross-cultural communication, Chinese, Russian.

Multicultural communication is a complex unity of verbal and non-verbal components of the sphere of interaction between representatives of different cultures. Unlike verbal communication, nonverbal communication, at first sight, is a simple way for people to interact. It is nonverbal means of communication that is used when people do not use each other's languages: communication occurs through intonation, gestures, facial expressions, motion, pantomime, images. The

share of all messages without the use of words accounts for 65% of the information that is transmitted in communication [1]. These symbolic means, as well as language means, represent information about the communicant himself.

In various classifications of nonverbal means of communication, kinesic (facial expressions, gaze, posture, gestures), prosodic, extralinguistic means (rhythmic intonation, speech speed, pause, and other voice signals) are distinguished [3]. These methods (symbols, signs) indicate the value system of the representative of the nation, set by the culture.

"A culture-defined value system is formed in the national community and can be identified by the verbal and behavioral manifestations of communicants [4]." Representatives of different nations verbally and nonverbally represent themselves in their judgments and opinions. They can characterize themselves in a certain way, based on their own understanding of themselves as a representative of the nation. This representation is referred to as autostereotypes [5]. Knowledge of the stereotypes expressed in the speech of the interlocutor helps both in personal communication and for a deeper development of the language and culture of the language being studied [6].

In our opinion, representatives of nations represent themselves most accurately through nonverbal communication. Gestures, facial expressions, involuntary movements in a special way tell about those who use them.

Nonverbal communication performs primarily a communicative and pragmatic function. G. V. Kolshansky believes that "sign language is neither a remaining part of the language system, nor an addition to the language. This is an indispensable behavior to compensate for deficiencies in oral communication, and it is a functional part of speech activity. This is related to each specific verbal communication." [2]. In Chinese communication, a pat on the shoulder to show friendliness and a close connection indicates that the Chinese are quite open about their attitude to the interlocutor – a friend, a relative. In Russian culture, such contact can be noticed not so often. But instead, the Russians embrace each other. The Chinese can also hug, but with more force, that is, squeeze their shoulders – 拍拍肩膀, 表示友好亲昵 to express sympathy and condolences. In Russian communication, this is a manifestation of a special emotional positive attitude towards a person.

Nonverbal communication is characterized by spontaneity and unconsciousness. When people talk, they unconsciously make certain facial expressions or gestures. As a rule, this is the true expression of people's inner emotions, which are extremely difficult to hide and suppress. A fairly frequent gesture that indicates that the Chinese value themselves very highly and sometimes

this is unjustified: "hands in your pants" – 双手装进口袋，表示放肆、无礼。It means arrogance and rudeness. In Russians, such a gesture is unacceptable in the society of unknown people and means unwillingness to communicate and disrespect.

Shrug – 表示不认同、吃惊、束手无策等 – expresses disagreement, surprise, helplessness in Chinese is a common gesture that underlines the reluctance of the Chinese to show the true attitude to the fact, a man.

The limitations of traditional culture are characteristic of sign language. Russian Russians and Chinese make a lot of gestures, while the Chinese (the Han people) limit their gestures to hand movements, and the frequency of their use is much lower. This is associated with the modesty of the Chinese. Basically, these gestures are associated with a positive attitude of the speaker, for example, rubbing your palms – 抚掌，表示满意、赞许 – to express satisfaction and approval. The younger generation of Chinese people are more free in their gestures. So, to show the "composition of three fingers" – 把大拇指从食指和中指中间伸出，表示蔑视、轻视对方。在中国的年轻人中也使用这样的手势来表示嘲弄 to express contempt and disdain towards each other. Such gestures are used to express ridicule.

In all types of communication, if we can use gesture language correctly, it will reduce the number of barriers to communication; avoid different kinds of misunderstandings and conflicts that can be caused by cross-cultural communication activities. Knowledge of the nonverbal system of a foreign communicant will allow one to find a more effective way of communication and discover new meanings of communication.

### References:

1. Журавлев А.Л. Социальная психология: Учебное пособие / А.Л. Журавлев, В.А. Соснин, М.А. Красников. – М. : ФОРУМ: ИНФРА-М, 2008. – 416 с.
2. Колшанский Г.В. Паралингвистика / Г.В. Кольшанский. – М. : Наука, 1974. – 80 с.
3. Морозов В.П. Невербальная коммуникация: Экспериментально-психологические исследования / В.П. Морозов. – М. : Изд-во «Институт психологии РАН», 2011. – 528 с.
4. Свердлов Н.А. Значение этнокультурных стереотипов в формировании речевой личности билингва // Жизнь в языке, культуре и социуме-7: материалы Международной научной конференции; Институт языкознания

РАН, РУДН; ответственный ред. Е.Ф. Тарасов. - М., Канцлер, 2018. - С. 140-142.

5. Тер-Минасова, С.Г. Язык и межкультурная коммуникация / С.Г. Тер-Минасова. - М., 2000. – 262 с.
6. Во Х., Sverdlova N.A. The importance of studying ethnic stereotypes in artificial bilingualism // Science Present and Future: Research Landscape in the 21st century. материалы научно-практической конференции с международным участием. ФГБУ науки "Иркутский научный центр Сибирского отделения Российской академии наук". 2020. С. 57-61.

*Scientific supervisor:*

*Nataliya A. Sverdlova,*

Ph.D. (Philology), Associate professor,  
Irkutsk Scientific Center, SB RAS, Irkutsk

УДК 811.161.1:37.02

**Irina I. Zolotareva**

*Department of pedagogics and expertise,  
Irkutsk Scientific Center, SB RAS, Irkutsk*

## **THE IMPORTANCE OF FORMING THE AUDITIVE COMPETENCE OF FOUNDATION COURSE STUDENTS**

**Abstract.** The article defines the auditive competence, emphasizes the importance of its formation for foreign students, and highlights certain features of the process.

**Key words:** competence, auditive competence, listening comprehension, auditive skills.

Receiving education in a foreign language, a person faces various difficulties. The formation of auditive competence can help in overcoming some of them.

Oral communication consists of speaking and hearing (listening), which in the methodology is called (listening) comprehension.

We should differentiate between “hearing” and “listening comprehension”. The first one denotes only the acoustic perception of sound, while listening comprehension is a receptive type of speech activity, which is a process of *perceiving sounding speech*, in addition to *listening* and *hearing*, it also presupposes *understanding* and *interpretation* of information perceived by ear.

Listening, along with speaking, provides an opportunity for communication in a foreign language. Since verbal communication is a two-way process,

underestimation of listening can have an extremely negative effect on the language training of students.

Listening is one of the most difficult types of speech activity. Usually a listener, especially perceiving a lecture, has no opportunity to change anything, cannot adapt the speaker's speech to his (her) own level of understanding. There are some objective difficulties that impede understanding of sounding speech: determined by the conditions of listening; due to the individual characteristics of the source of speech; due to the linguistic characteristics of the perceived material.

Teaching students to understand spoken speech is one of the most important learning goals. Listening as a teaching tool provides students with new language and speech material, acts as a means of developing skills and abilities in all other types of speech activity, contributes to maintaining the achieved level of speech proficiency, and forms auditive skills. That is why we could say that listening determines not only the effectiveness of all practical language training, but also the success of socialization at the university.

The competence-based approach, reflected in the educational standards of the new generation, allows us to assert that nowadays the process of foreign language education should be considered in terms of competencies.

Competencies are understood as “integral dynamic characteristics of a student (graduate), which express the expected and measurable learning outcomes (knowledge, skills, personal qualities), ie. achievements of the graduate, his (her) readiness and ability to carry out certain types of activities after mastering the entire course or its separate part" (Folomkina S.K.)

This concept has not yet found a detailed reflection in the modern scientific literature, its content as a fundamental characteristic of the possession of auditing activities has not yet been disclosed, the indicators of the formation of this competence have not been determined. The latter should include both qualitative and quantitative characteristics, as well as reflect the requirements for both the listening process and its result.

With regard to 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.

Based on the above characteristics, foreign language auditive competence can be defined as a complex integrative characteristic of a listener, which characterizes his (her) 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 (naturalness) of perception. These indicators are interdependent 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 changing environment.

*Scientific supervisor:*

*Nataliya A. Sverdlova,*

Ph.D. (Philology), Associate professor,  
Irkutsk Scientific Center, SB RAS, Irkutsk

УДК 81-26

**Elena P. Mariasova**

*Department of pedagogics and expertise,  
Irkutsk Scientific Center, SB RAS, Irkutsk*

## **ON AGONALITY IN WRITTEN SCIENTIFIC DISCOURSE**

**Abstract.** The author proposes the main elements of the study of agonality, represented in the language of written scientific communication. It has been established that the set of linguistic markers of agonality depends on a number of factors related to the addressee, addressant, and the scientific area the studied discourse belongs to.

**Keywords:** agonality, cognition, scientific discourse, written scientific discourse, agonality markers.

The attainment of objectives and desired results in a scientific research depends on various factors, related, primarily, to the organization of the methodological and procedural basis of scientific activity. The most significant component of research work is cognitive process per se, which leads to the emergence of new aspects of the research object, the expansion of the scientific subject area, along with the proof of hypotheses, and new scientific challenges and goals.

The principles of cognition in modern epistemology limit a person on his way towards truth within the framework of dialectics, historicism, practice, cognizability, objectivity, and concreteness. The principles of scientific communication start from evidence-based truth, (“Science begins where one begins to measure” (D. Mendeleev)), and then are based on the causality and relativity of scientific knowledge.

The limitation and relativity of scientific knowledge regulates the emergence of new ideas and provokes a critical analysis of existing ones. That is exactly why, in scientific communication, a clash of conflicting viewpoints is not uncommon. Additionally, the absence of such opposition is significant for understanding how scientific the opinions expressed are.

Thus, *agonality* is considered an essential characteristic of scientific speech, both written and oral. Agonality in scientific discourse is understood as the principle of the cognitive process, with the obligatory presence of opposing sides, which results in an intense confrontation of points of view. Conflicting points of view are conditioned by various pragmatic goals of the participants in academic communication and reflecting competitiveness of the participants in the cognitive process in order to achieve consensus or, on the other hand, victory or superiority over the opponent (Solovyanova, 2020)

Among the types of discourse agonality selected by E. Sheigal and V. Desheva (Sheigal, Desheva, 2009), we distinguish "debatable agonality" aimed at solving the communicative task of establishing the truth. The dispute, as a prototype of agonality, is realized in the assertion of one's own scientific position, along with criticism of the opponent's scientific position. In the research object of our study- a scientific written text (hereinafter, referred to as ‘articles’) – markers of "dispute" are usually few, and their number depends on the scientific area of the research subject. Thus, scientific texts on philosophy are most favorable in terms of confrontation, objectified in multifarious linguistic markers. In contrast, texts on mathematics are not so “fruitful”, so chances to find indicators of scientific controversy, agon, are minimal.

Obviously, the set of linguistic markers for the realization of agonality depends on a number of extralinguistic factors, prominent among which are the characteristics of the producer (addressant) and those of the receiver of information (addressee). The set of linguistic means representing agonality - epithets, metaphors, allusions, nominations – can also depend on the scientific area of the discourse under the study; but agonality markers are indispensable for scientific written discourse as it is.

## References:

1. Solovyanova E.V. (2020) Agonality in academic discourse. Extended abstract of dissertation for scientific degree of Candidate of Philological Sciences. Voronezh, 24p. [in Rus] ([https://viewer.rusneb.ru/ru/000199\\_000009\\_010244589?page=1&rotate=0&theme=white](https://viewer.rusneb.ru/ru/000199_000009_010244589?page=1&rotate=0&theme=white));
2. Sheigal E.I., Deshevova V.V. (2009) Agonality in communication: concept structure. Vestnik, Chelyabinsk State university/ N34 (172), Philology and Arts, Vol.36, 145-148 pp. [in Rus]
3. Bazhenova E. A. (2009) Scientific text in the discursive and stylistic aspect/ Vestnik, Perm State university. Russian and foreign philology, Vol.5, 24-32 pp. [in Rus]

***Scientific supervisor:***  
*Nataliya A. Sverdlova,*  
Ph.D. (Philology), Associate professor,  
Irkutsk Scientific Center, SB RAS, Irkutsk