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ТРАНСФОРМАЦИЯ ОКРУЖАЮЩЕЙ СРЕДЫ И УСТОЙЧИВОЕ РАЗВИТИЕ В АЗИАТСКОМ РЕГИОНЕ

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Трансформация окружающей среды и устойчивое развитие в Азиатском регионе / Материалы Международной научной конференции (Иркутск, 08–10 сентября 2020 г.). – Иркутск: Изд-во Института географии им. В.Б. Сочавы СО РАН, 2020. – 186 с.

В сборнике опубликованы тезисы докладов Международной научной конференции «Трансформация окружающей среды и устойчивое развитие в Азиатском регионе». В статьях авторы делятся опытом решения фундаментальных научных проблем в области оптимального экологически ориентированного ресурсообеспечения природопользования и жизнедеятельности населения, а также устойчивого развития трансграничных территорий и регионов, имеющих тесные внешние экологические и социально-экономические связи со странами Северо-Восточной Азии. Особое внимание уделяется изменению природных комплексов в условиях возрастающего антропогенного воздействия на глобальном уровне, сохранению окружающей среды и взаимодействию стран и организаций, как на трансграничных участках, так и в регионах совместного социально-экономического интереса. В рамках конференции обсуждались вопросы развития и совершенствования объективных методов обработки географической информации, новые пространственно-временные модели для анализа и разработки стратегий устойчивого природопользования, «зеленой» экономики и регионального развития, геоинформационные, дистанционные и картографические методы анализа и представления данных о текущем состоянии, временной динамике и трансформации природных и социально-экономических систем.

Сборник ориентирован на широкий круг ученых-географов и экономистов, преподавателей, учащихся высших учебных заведений и представителей органов государственного управления различного уровня, интересующихся проблемами экологии, эффективного природопользования и территориального развития.

Редакционная коллегия: к.г.н. *Владимиров И.Н.* – отв. ред., к.г.н. *Мядзелец А.В.,* к.г.н. *Цыганкова М.В.,* к.г.н. *Василенко О.В.,* к.г.н. *Шеховцов А.И.*

Environmental transformation and sustainable development in the Asian region. Proceedings of the International scientific Conference (Irkutsk, September 08–10, 2020), Irkutsk: Sochava Institute of Geography SB RAS, 2020. – 186 p.

The proceedings of the International scientific Conference “Environmental Transformation and Sustainable Development in the Asian Region” were published in the collection. The publication features articles on solving fundamental scientific problems with the authors sharing their experience in the field of optimal environmentally-oriented natural resource use and livelihoods of the population, as well as sustainable development of transboundary territories and regions with close external environmental and socio-economic ties with the countries of Northeast Asia. Particular attention is paid to changes in natural complexes under increasing human-induced impact at the global level, environmental preservation and interaction of countries and organizations both in transboundary areas and in regions of joint socio-economic interest. The conference discussed the development and improvement of objective methods for processing geographic information, new spatio-temporal models for analysis and development of strategies for sustainable environmental management, green economy and regional development, geoinformation, remote and mapping methods of data analysis and presentation on current state, temporal dynamics and transformation of natural and socio-economic systems.

The collection is aimed at a wide range of geographers and economists, teachers, university students and representatives of government bodies of various levels interested in the problems of ecology, effective environmental management and territorial development.

Editorial board: Dr. Sc. (Geogr.) *I.N. Vladimirov* - Editor-in-chief, Dr. Sc. (Geogr.) *A.V. Myadzelets*, Dr. Sc. (Geogr.) *M.V. Tsygankova*, Dr. Sc. (Geogr.) *O.V. Vasilenko*, Dr. Sc. (Geogr.) *A.I. Shekhovtsov*

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ПРЕДИСЛОВИЕ

Уважаемые читатели! Коллеги и друзья!

Перед вами сборник тезисов Международной научной онлайн-конференции «Трансформация окружающей среды и устойчивое развитие в Азиатском регионе», проводимой Институтом географии им. В.Б. Сочавы СО РАН.

Конференция проводится в не совсем обычном для многих дистанционном он-лайн-формате, но текущий 2020 год, современные информационные технологии и новые вызовы нашего времени расширяют возможности для проведения научных мероприятий, позволяя нам встречаться даже на значительном расстоянии друг от друга.

Сборник тезисов отражает все основные направления научной работы конференции, включая анализ роли трансграничного фактора в рациональном использовании ресурсов, управлении природопользованием и формировании «зеленой» экономики, перспективы устойчивого развития внутренних и трансграничных территорий Азиатского региона в условиях глобальных изменений, исследование трансформации и динамики природных и природно-антропогенных комплексов и их компонентов, а также применение новых методов и технологий обработки географической информации с использованием данных дистанционного зондирования, ГИС и математического моделирования для решения различных географических задач. Отдельный раздел посвящен вопросам географического образования и образовательным функция окружающей среды в современных концепциях устойчивого развития. Рассуждения, мнения и новые результаты научных исследований читатель найдет в коротких, но информативных сообщениях данного сборника.

Проводимая Конференция является площадкой для совместного поиска решений фундаментальных научных проблем в области оптимального экологически ориентированного природопользования, устойчивого развития трансграничных территорий и регионов, имеющих тесные внешние экологические и социально-экономические связи со странами Северо-Восточной Азии. Особое внимание необходимо уделить изменению природных комплексов в условиях усиливающегося антропогенного воздействия на глобальном уровне, сохранению окружающей среды и взаимодействию стран и организаций как на трансграничных участках, так и в регионах совместного социально-экономического интереса.

Совместные обсуждения, в том числе в дистанционном формате, по обозначенным вопросам дают возможность укрепить установленные и завязать новые научные связи и международное сотрудничество в сфере трансграничного территориального развития, охраны окружающей среды и экологии с целью нахождения точек соприкосновения и выдвижения конструктивных предложений по модернизации экономики регионов, транспортной и социальной инфраструктуры, реализации принципов «зеленой» экономики и природопользования.

Организаторы надеются, что данная конференция станет важным событием, стимулирующим расширение международного сотрудничества по географическим и экологическим проблемам, в ходе обсуждения докладов удастся не только получить новые знания, но и прийти к согласованным решениям по многим проблемам, а новый виртуальный формат, стирая границы, расстояния и экономические препятствия, привлечет участников из самых разных уголков земного шара.

Директор Института географии им. В.Б. Сочавы СО РАН, к.г.н.
Владимиров Игорь Николаевич

FOREWORD

Dear readers, colleagues and friends,

below we present the proceedings of the International scientific Online Conference "Environmental Transformation and Sustainable Development in the Asian Region" held by the Sochava Institute of Geography SB RAS.

An online conference is not quite usual, but the current 2020, modern information technologies and new challenges expand the possibilities for holding scientific events, allowing us to meet even being separated from each other.

The collection of abstracts reflects all the main fields of scientific work of the conference, including analysis of transboundary factor's role in sustainable use of resources, environmental management and green economy promotion, sustainable future of internal and transboundary territories of the Asian region in response to global changes, study of transformation and dynamics of natural and natural-anthropogenic complexes and their components, as well as implementation of new methods and technologies for processing geographic information using remote sensing data, GIS and mathematical modeling to solve various geographic problems. Special session is devoted to issues of geographic education and educational function of the environment in the comprehensive concepts of sustainable development. A reader can find discussion, opinions and key research insights in the short but informative messages of this collection.

The conference is a platform for collaborative search for solutions of fundamental scientific issues in the field of optimal environmentally-oriented nature management, sustainable development of transboundary territories and regions with close external environmental and socio-economic ties with the countries of North-East Asia. Particular attention should be paid to changes in natural systems under increasing anthropogenic impact at the global level, environmental preservation and interaction of countries and organizations both in transboundary areas and in regions of joint socio-economic interest.

Joint discussions even remotely provide an opportunity to strengthen the established and establish new scientific ties and international cooperation in the field of transboundary territorial development, environmental protection and ecology in order to find common ground and advance constructive proposals for modernizing the regional economy, transport and social infrastructure, implementation of the principles of green economy and environmental management.

The organizers hope that this conference will become an important event stimulating the expansion of international cooperation on geographic and environmental issues, and discussions will result not only in new knowledge, but also in agreed solutions on many problems, and a new virtual form will attract participants from all over the world, erasing boundaries, distances and economic obstacles.

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SESSION 1. «THE ROLE OF THE CROSS-BORDER FACTOR IN THE RATIONAL USE OF RESOURCES, ENVIRONMENTAL MANAGEMENT AND THE FORMATION OF GREEN ECONOMY»

EXPERTISE OF THE RAS TO ENSURE THE CONSISTENCY OF SOLUTIONS TO APPLIED PROBLEMS WITH THE RESULTS OF FUNDAMENTAL RESEARCH

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The status of the RAS Expertise in Russian legislation is enshrined as an indicator of the highest qualifications of expertise, scientific substantiation and the exclusion of conflicts of interest, as well as the absence of tools to challenge it, allow us to count on the effectiveness of the use of this institution in the field of environmental management and the formation of a "green" economy. The problem of eliminating the accumulated damage from the activities of the Baikal Pulp and Paper Mill (BPPM) can support the extension of the RAS Expertise system to significant, from the standpoint of state interests, projects for the rehabilitation of closed and creation of new especially dangerous facilities, the prevention of environmental disasters, etc. The Methodology descripted for the RAS examination of technological proposals for the elimination of accumulated environmental damage as a result of the activities of JSC "BPPM" was developed in terms of technical applicability and compliance with the requirements of the legal regime of the Central ecological zone of the Baikal natural territory. The fundamental conditions of these expert works should be considered:

- the inclusion of the Expertise of the Russian Academy of Sciences in the complex of measures for scientific support of the implementation of national development goals of Russia;
- the customer cannot be an organization offering technical solutions of affiliated persons for examination;
- materials for the examination must comply with the uniform requirements for the completeness and quality of information;
- adversarial nature of the examination process;
- the examination procedure should be provided with several levels of verification of the results, while maintaining the confidentiality of information about the identity of the experts and the work they perform.

TRANSBORDER PROTECTED AREAS SYSYEM OF CHINA AND RUSSIA ACCORDING TO CHALLENGES FACING OF THE BELT AND ROAD PROJECT IMPLEMENTATION

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China is the belt and road initiative aimed at creating a new model of international economic cooperation. Building an ecological civilization is vital to sustain the Chinese nation's development. Its strategic initiative of the Belt and Road (BRI), aimed at creating a new model of international economic cooperation also so BRI appears to be a multi-purpose project to create a new model of globalization, and at the same time, this is the way to a common Eurasian economic space, in which China plays a system-forming role in the world.

Russian President Vladimir Putin supports the Chinese project and there are already many initiatives to combine various integration processes going on in Europe and Asia. The modern network of protected areas of Russian Federation formed over the last 100 years and only recently, the construction of China's Protected Areas has entered the substantive stage. Environmental policy, actively pursued by the Chinese state, can become one of the most powerful tools in the protection of the environment, in which the protection of the human environment goes from providing an applied function to the most important tasks of the national ideology, which will be true in relation to Russia.

Now governments and social organizations different countries should process establishing a mechanism for the co-construction of the «Cross-border Special International Nature Reserve System». The main goal is to build East-Asian ecological network, which focus on a vision of ecological targets for the intermediate and long-term and promote public awareness, education and information programs through environmental interpretation. The practical work such as facility construction and service upgrading urgently needs theoretical support and scientific guidance, especially concerning sustainable development, where a great role-plays transborder environment problems.

China has vigorously promoted the ecological civilization construction and strived to build beautiful China, the pilot work of national parks started in 2015 and after three years of pilot exploration, protected Area (PA) plays an important role in the construction of ecological civilization in China. China President Xi Jinping pointed out the task of "Establishing Protected Areas System with National Parks as its Center" in next five years. Fundamental development of "green" technologies to prevent new and solve existing environmental problems, balance economic development and environmental protection, coinciding with the transfer of many industries from the East to the West of China.

It is necessary to consider the territory of neighboring countries, with the active participation of the country in international investment and financial policy. The plan puts forward that China's national parks will give top priority to ecological protection, focus on improving ecosystem service functions, carry out natural environment education, raise public awareness of protection, and encourage public participation in the environmental preservation. The paper presents some necessary core development of protected areas in light of biodiversity conservation and wilderness preservation, aiming on future generations.

CREATING GEOINFORMATION SYSTEM (GIS) AS AN INSTUMENT ON PUBLIC MONITORING OF THE LARGE INFRASTRUCTURE PROJECTS IN THE SOUTH OF THE RUSSIAN FAR EAST

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During the latest decade the perspectives of business development in the Russian Far East (RFE) is the focus of investors' special attention and received preferential treatment from the Russian Government. At the same time there is a value growth of the land, with its great natural resource potential yet under the threat of extensive use of natural resources. However, under government authorities supervision, this is the place where special priority development territories were organized, Far Eastern Hectare program was launched, special state benefits for settled populations and newcomers get assigned, etc. All of this should create favorable conditions for doing business and accelerating development in the RFE, with the priority for the large infrastructure projects implementation.

It should be highlighted that all possible threats for both nature potential and regional social development should be assessed at the stage of development. Otherwise incorporation of any changes at the follow up stages will lead to much more expenses for the investors, as well as to much more danger for the local population. This goal cannot be reached without comprehensive evaluation of the natural conditions of the territories with consideration of the inter-sectoral analysis of the possible and existing nature management in the RFE.

To address the related objectives, we used the up-to-date instrument GIS where we conducted express-analysis of the potential risks for conservation of the natural potential, geographically combining materials of various invest-projects, existing scheme of the social and infrastructure objects, as well as especially valuable natural territories. Nowadays Cadastre and Real Property Agency conducts the similar activities. Anyway, their main goal is mapping the boundaries and land registration, while we try to identify possible environmental risks in advance and, jointly with the public, choose environmentally and socially acceptable large-scale constructions in the region.

Now our map is available on-line (https://arcg.is/eG8r5) as a tool to identify all possible threats for major nature and valuable objects (such as high conservation value forest, protected areas, cedar-broad-leafed and intact forests, wetlands and others) in the Russian Far East. Geoinformation database on the possible large infrastructure projects has the detailed description of each object, including the necessary capital volume for realization and information about the potential harmful impact on the precious natural assets. All the available data is being posted for public access together with adjustment of the analysis tools, to provide the verified information about the most valuable naturals assets in the RFE for the attention of the potential investors and decision-makers.

Our database was developed based on different data including posted in internet planning schemes of the related territories, invest offers and lots of industry documents on regional development. Objects in the database could be conditionally divided into several categories, such as: transport (transport corridor, bridge crossing, rail/auto roads, pipeline, sea port, terminal logistics center); energy (energy transfer object, power generation, oil and gas); agriculture (livestock or agro-industrial complex); forest industry (timber processing complex); subsoil use (mining operations, metal manufacture, mining and processing integrated plant); integrated.

Historically, the RFE business has not been based on the corporate social responsibility, which already caused lots of complex problems with landscapes degradation. Today we should reconsider the existing model of nature management for not only both biodiversity conservation and local population's livelihood improve, but also for making business in the region competitive, socially responsible and having access to international markets. This is very important for the sustainable development of the RFE local communities and for the entire Russia as all the natural resources here and its unique biodiversity represent value assets promoting investment attraction.

ASSESSMENT OF THE WELL-BEING OF REGIONAL DEVELOPMENT TAKING INTO ACCOUNT THE ENVIRONMENTAL COMPONENT

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The problem of taking into account the environmental factor in assessing the achieved level of economic development is actively discussed around the world in the ecological and economic scientific literature. In some Russian regions where the economy is built around the raw materials industry, the level of negative impact on the environment is very high. This situation is also typical for most of the territories in the East of the Russian Federation, where the economic development is still based on natural resources.

The purpose of this work is to study the socio-ecological and economic well-being of the Eastern regions of Russia using a multiplicative model based on the A. Sen extended function (Sen, 1976). This model was adapted for the study of the social well-being of Russian regions (Malkina, 2017). It concludes four components: gross regional product (GRP) per capita, the share of personal incomes in GRP, the cost of living index in the region and the intra-regional income inequality. This multiplicative model can be expanded to include new welfare components. In this study, we will supplement it with an integrated environmental index that takes into account an important component of well-being: the quality of the natural environment. It is defined as the arithmetic mean of the specific environmental indices calculated on the basis of the following indicators: share of the negative water and air tests (Ryumina, 2016).

Calculations revealed that a high level of social welfare obtained on the basis of the four-component multiplicative model (i.e. without taking into account the environmental factor) is observed in the Republic of Sakha (Yakutia), Magadan Region and Sakhalin Region. These natural resource territories are included in *top*-20 Russian regions in terms of GRP per capita. Among the border regions, the Khabarovsk territory stands out in terms of social well-being. According to the A. Sen extended function, the following regions of cross-border cooperation were the least prosperous: the Jewish Autonomous Region and the Trans-Baikal Territory. The inclusion of an environmental component in a comprehensive assessment of social well-being has had a significant impact on the outcome of this assessment. In most of analyzed regions, the ecologically adjusted characteristic was significantly lower than the indicator obtained on the basis of the four-component multiplicative model (without the environmental component). The most significant difference is observed in the Jewish Autonomous Region, Magadan Region and the Republic of Sakha (Yakutia). The results obtained can be used in the development of management decisions in the field of environmental and economic interactions, as well as in the preparation of strategic planning documents.

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THE EFFECTIVENESS OF SOLAR RESOURCES FOR OFF-GRID POWER SUPPLY IN THE CROSS-BORDER TERRITORY OF RUSSIA AND MONGOLIA

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The central part of the cross-border territory of Russia and Mongolia is occupied by unique basins of Lake Baikal and Lake Hövsgöl. In the zone of these lakes, there are two unique national parks (the Tunkinsky and the Hövsgölparks) (Kalikhman, 2012). These parks are specially protected natural territories.

Currently, specially protected natural territories are actively involved in ecotourism and integrated into the sphere of socio-economic development, i.e. new economic mechanisms for their operation are introduced; budget funding is increased; participation in environmental projects funded by international organizations expands (Evstropieva, 2009, 2014).

The main part of the territory is provided with electricity by long radial power lines. Remote consumers are supplied with electricity by inefficient diesel power plants. The current state of the power supply system within the Baikal-Hövsgöl cross-border territory is characterized by low voltage level for the consumer and low reliability. The availability of solar resources was considered using various data (Scientific and Applied Reference Book on Climate of the USSR, 1991; Reference Book on Climate of the USSR, 1966; NASA Prediction of World Energy Resources). In the coastal areas of Lake Baikal, the total solar radiation on a horizontal surface varies from 1100 kWh/m^2 in the north to 1250 kWh/m^2 in the south, with an increase in some localities up to 1300 kWh/m^2. High solar potential indices are also observed in the cross-border Baikal-Hövsgöl territory, especially in the area bordering Mongolia and in the northern part of Lake Hövsgöl.

Since there are no single sources for assessing the solar potential in the territory of both states, NASA (NASA Prediction of World Energy Resources) materials on the average monthly total radiation reaching a horizontal surface, given the cloud cover for the period from 1981 to 2015, were taken as the input data for calculations.

To assess the effectiveness of introducing solar energy, we have calculated technical and economic indices of a photovoltaic module. The calculations have indicated rather high values of capacity factor (slightly less than 20%). Solar power plants appear to be the most economically feasible when compared to other renewable resources (wind energy), because they have the lowest average electricity production cost over 25 years – 4.9-5.3 Rub/kWh (for wind turbines this parameter is 15-17 Rub/ kWh).

The study has considered several options for commissioning solar power plants at some locales. The cost-effectiveness of solar power plants for autonomous power supply to remote stationary (tourist centers, settlements) and mobile (mobile livestock stations) facilities is achieved by displacement of diesel fuel.

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IMPROVEMENT OF AIR POLLUTION EMIISION FEES

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Due to the ongoing urbanization, the effects of economic activities have adverse impact on environmental sustainability. Such negative environmental effects are stipulated by transboundary pollution. This problem is cross-regional in scope as it implies air transport of hazardous substances over long distances and throughout various regions. Therefore, the state regulation of hazardous air pollutants is of particular importance.

Air quality is deteriorating in many regions of the Russian Federation. According to the national reports on "The State and Protection of the Environment in Tomsk Oblast", there was an increase in annual mean concentrations of air pollutants in Tomsk during 2015 – 2018. The highest mean consternations are observed for the following substances: nitrogen dioxide (from 0.045 MAC to 0.8 MAC), suspended substances (from 0.104 MAC to 0.7 MAC), hydrogen chloride (from 0.063 MAC to 0.6 MAC), formaldehyde (from 0.014 MAC to 0.5 MAC, with the exceed up to 1.5 MAC being registered in 2017).

According to the Resolution dated 22.12.2017 No.165 on the approval of hygienic normatives GN 2.1.6.3492-17 "Maximum allowable concentrations of *pollutants in* the *air* of urban and rural settlements" (including the amendments dated 31.05.2018), maximum allowable concentrations of pollutants are determined for 658 urban and rural settlements, while the fee rate for emissions of air pollutants from stationary sources is specified for 159 substances (The RF Government Resolution dated 13.09.2016 No.913 (including the amendments dated 24.01.2020) "On fee rates for adverse impact on the environment and additional coefficients"). Thus, the fee rate for almost 500 pollutants is zero.

The present article analyzes the data on maximum allowable concentrations and fee rates for emissions of air pollutants. Based on the analysis results, the strategy to determine the fee rates for emission of air pollutants has been proposed. It includes a specific type of graduation scale which comprises the data on maximum allowable concentrations since this criterion indicates a real threat to the environment.

Thus, the following formula is proposed for the air pollutants which have not been still charged:

$$Y=2/X,$$

where Y – the proposed fee rate per 1 tone of pollutants,

X – the daily average MAC for pollutants.

Based on the regression analysis of the existing emission fee rates and maximum allowable concentrations, coefficient 2 was calculated.

The proposed strategy is a simple and universal technique to calculate the fee rates for adverse environmental effects resulted from harmful emissions into the air.

Thus, it is possible to calculate the fee rate for emission of a certain pollutant without any particular effort and staff time. The introduction of the proposed strategy would allow filling the gaps in the environmental governance in the shortest possible time.

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TRANSFORMATION OF THE PROTECTED AREA SYSTEM OF SIBERIA IN 2010-2020

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By 2020 protected areas in Siberia are represented by all the main categories of various levels of subordination mentioned in the Federal law "On protected areas", and it also provides for the possibility of creating other categories of spas at the discretion of the regions. In particular, in Yakutia there are regional protected areas of the category "resource reserves" and "protected landscapes", in the Tyumen region – "natural and historical complex" and "environmental monitoring polygon", which have areas that are important for territorial nature protection.

Categories of protected areas have differences in the nature protection regime, the list of tasks, their functioning, and the possibility of spatial differentiation of the territory. The most strict regime for preserving the natural environment is inherent in nature reserves (zapovednik), but since 2011, so called "educational tourism" has been allowed on their territories, and capital construction has been allowed on biosphere polygons.

During the period under review, there was a tendency to include federal protected areas of various categories in the united directorates. In particular, at the beginning of 2012, the first joint directorate "Zapovednoye Podlemorye" was created, which included the Barguzinsky reserve, the Zabaykalsky national park and the Frolikhinsky zakaznik of federal significance, in 2013 "Taimyr reserves" included the three largest reserves in Russia "Big Arctic", "Taimyrsky" and "Putoransky", as well as the federal zakazniks "Severozemelsky" and "Purinsky", in 2014 "Zapovednoye Pribaikalie" connecting the protected areas of the western coast of lake Baikal: the "Baikal-Lensky reserv", the "Pribaikalsky national park", the zakazniks of federal significance "Krasny Yar "and "Tofalarsky" located at a significant distance from Irkutsk. In the vast majority of regions, republics and territories of Siberia, directorates of regional protected areas or special departments under regional administrations have been established.

Since 2010, after a period of stagnation in the development of the protected area system, new federal and regional protected areas have appeared. The "Vasyugansky reserve", national parks "Saylyugemsky", "Chikoy", "Kodar", "Lena Pillars", the zakazniks of federal significance "Pozarym" and "Dzeren Valley", natural parks "Ak-Cholushpa", "Khakassia", "Tyva", and 29 zakazniks of regional significance have been created.

The Kemerovo region remained unchanged in the protected area system.

In general, 421 protected areas of the main categories are currently functioning in Siberia, which includes 14 subjects of the Russian Federation, the Siberian federal district and parts of the Far East (the Republics of Sakha(Yakutia) and of Buryatia, the Zabaikalsky kray) and the Ural (Tyumen region with the Yamalo-Nenets and Khanty-Mansi districts). Of these, 58 protected areas of federal significance (27 reserves, 8 national parks, 23 zakazniks) and 363 protected areas of regional significance (27 natural parks, 272 zakazniks, 63 resource reserves in Yakutia and 1 environmental monitoring site in the Tyumen region).

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EFFICIENCY OF USING WASTES FROM FORESTRY AND WOOD PROCESSING FIELD FOR HEAT SUPPLY OF BAIKALSK CITY

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The problem of heat supply of the Baikalsk city has been discussed since 2013, when the Baikal Pulp and Paper Mill closed. Currently the source of heat energy is the Baikal Thermal Power Plant. The steam boilers installed at the Thermal Power Plant were designed to jointly provide steam for the technological processes of the plant and for heating supply the Baikalsk city. After the closure of the Baikal Pulp and Paper Mill, the boiler capacity became redundant. There is a significant excessive consumption of fuel. Thermal Power Plant equipment is worn out. Replacing existing boilers with similar coal-fired boilers is not permissible given the current environmental restrictions in the central ecological zone of the Baikal natural territory. Therefore reconstruction of the Thermal Power Plant is planned in the Baikalsk city. One of the most likely options is the using of biofuels boilers.

A comparison of the cost of wood chips and pellets produced from wood from sanitary felling in the immediate vicinity of the Baikalsk city and the cost of pellets purchased from existing pellet plants is made.

1. For the production of biofuels for the Baikalsk city, wood can be used from sanitary felling in the area of the Anchuk. According to estimates by the Ministry of Forest Resources of the Irkutsk Region (2018), approximately 9.5 million m^3 of woods are concentrated there. If the share of waste is 40%, then in absolute terms this will amount to 3.8 million m^3 of wood for energy purposes. When fuel demand energy of the Baikalsk city and adjacent tourist facilities of 250 thousand Gcal of this stock of wood should be enough for 18 years. The cost of wood harvested in the process sanitary felling is about 1800 rubles per ton.

For the production of wood chips, it is advisable to grind and dry of the biomass on the place of forest logging to a moisture content of 8-10%, providing a relatively uniform fractional composition. The cost of wood processing (drying and grinding) is about 1200 rubles per ton, the cost of transportation to Baikalsk is 620 rubles per ton. Considering the cost of raw materials, the cost of wood chips is estimated at about 3600 rubles per ton.

Pellet production is practically waste-free. In addition, in the future it is advisable to study the possibility of adding 10-20% lignin to pellets and thus to solve the problem of its utilization and increase the biofuel resources. When the cost of electricity is 3.5 rubles per kWh, the total technological costs for the production of pellets are about 3 thousand rubles per ton, transportation costs – 200 rubles per ton. Taking into account the cost of raw materials, the cost of pellets is estimated at 4.5 thousand rubles per ton.

2. The largest pellet plant near the Baikalsk city is located in the Ust-Barguzin (490 km). Selling price – 7000 rubles per ton. Taking into account delivery, the cost of pellets is estimated at 8.5 thousand rubles per ton.

The decision about choosing the type and place production of biofuel should be made on the basis of data about the distance of transportation from the place of processing of wood and the cost of raw materials.

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CULTIVATED LANDS OF THE TRANSBOUNDARY AMUR RIVER BASIN: CHANGES IN THE BEGINNING OF THE XXIST CENTURY

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The area of the transboundary Amur River Basin, located in the adjacent territories of Russia, China and Mongolia, exceeds 2 million km2. Agriculture is one of the main factors of environmental changes in the basin during last 150 years. In the early 2000s, cultivated lands occupied over 373 km^2 or about 20 % of the basin's territory, and 77 % them located on the Chinese territory, 22 % – on the Russian part, 0.7 % – on the Mongolian one (Ganzei et al., 2007). The aim of this work is to assess the dynamics of cultivated land in the Amur River basin for the period from 2000 to 2017. The basis for the work is official statistics, mainly such indicator as sown area of all crops in farms of all categories.

In the XXIst century, agricultural production had unequal dynamics in the different parts of the river basin. On the Chinese territory, it was actively developing, that confirming by increasing of agricultural production and expanding of cultivated land. On the Russian and Mongolian territories, in the first 5-10 years of the new century, the industry experienced a crisis that began in the 1990s, which was accompanied by decreasing of production volumes and shrinkage of agricultural land. However, since 2010, in all three countries, there has been an increase in agricultural production and expansion of sown areas.

Cultivated land changes in the Amur River basin were analyzed at several spatial levels. First of all, the change in cultivated areas within the 3 national parts of the basin (Russian, Chinese, and Mongolian) was assessed. Earlier, for such assessments, we used data of the provincial level in the Chinese territory, krais and oblasts – in the Russian one, aimaks – in Mongolian one. However, since not all of these administrative units are fully located in the Amur basin, estimates were expectedly overstated. In this work, we use data reflecting the situation at the level of regions and counties in the provinces of China, municipal districts and urban districts – in Russia. Unfortunately, for the Mongolian territory only data on aimaks are still available. Using of data for more detailed level of administrative division made assess of cultivated land changes in the area of in the territory of each country within the Amur basin more accurate. As our calculations showed, the greatest changes occurred in the Chinese territory, where from 2004 to 2017 the total sown area has increased at least from 14.4 to 22 million ha. The sown area in Heilongjiang Province has increased especially significantly – from 9.7 to 14.8 million hectares. Sown areas in the Russian part of the basin increased over the same period by 0.8 million ha, amounting to 2.14 million ha in 2017. On the Mongolian territory for the period 2005-2017 the total area under crops increased by almost 2.5 times and reached 58.3 thousand ha.

To study the spatial distribution of cultivated lands within separate administrative territories of the provincial level, we compiled a series of cartograms showing the share of cultivated land in the total area of regions, counties districts and aimaks in 2004-2005 and 2017, as well as cartograms reflecting changes in this indicator. Analysis of cartograms of two time slices allowed determining the main trends in the distribution of cultivated lands in the Russian and Chinese parts of the basin, as well as to calculate transboundary gradients and characterize the situation with agricultural land use in the border territories of the three adjacent countries. In addition, we made an attempt to calculate the cultivated land changes for some large river basins in the Chinese and Russian parts of the Amur River watershed.

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REGULATORY ECOSYSTEM SERVICES OF GREEN INFRASTRUCTURE (CASE STUDY OF JAPAN)

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The concept of ecosystem services is relatively new; this term was first introduced into scientific circulation in the late 1960s. The use of such tool as ecosystem services can be considered a kind of preparatory stage of the transition to paid nature management, because the modern society is becoming aware that if ecosystems can provide certain "services", it means that these services must be paid for.

Ecosystem services are all those benefits that people receive from ecosystems. The most detailed analysis of ecosystem services was given in the final report of the international work program "Millennium Ecosystem Assessment" (2005). Four types of ecosystem services are distinguished: providing, regulatory and cultural services, as well as supporting services that are necessary for the production of all other ecosystem services. Regulatory services include climate and disease regulation, protection against disaster, as well as treatment of air and water, and others.

The concept of "green infrastructure" is actively developing in the practice of territorial planning of developed foreign countries since the early 1990s, but has not yet become widespread in Russia. Japan has achieved great success in this field. The "green infrastructure" includes both natural areas (forests, meadows, wetlands, and others), and artificially created green spaces. Various components of the "green infrastructure" perform the following regulatory functions: local and global climate control, river flow regulation, groundwater retention and accumulation, prevention of soil erosion, protection against floods and other dangerous natural processes, purification of air and water, and others.

Japan has a long tradition of integrated, multifunctional use of various elements of green infrastructure. The current intensification of the Japanese economy, along with such processes as population decline and aging, especially in rural areas, leads to a significant loss of many important ecosystem functions and services. At the present stage, much attention is paid to the maintenance of traditional methods of nature management in order to preserve ecosystems and their services. The article examines ecosystem services of various elements of the "green infrastructure" of Japan such as forests, paddy fields, coastal landscapes, and others.

Forests occupy almost 70% of the country's area. They play very important role in Japanese nature and culture and provide many ecosystem services including not only material support (production of wood and other natural materials), but also intangible, such as regulatory, supportive and cultural.

The most characteristic type of cultural landscape in Japan is paddy fields. Historically, they served not only to their intended purpose - the production of the main Japanese food crop - rice, but also provided a range of diverse ecosystem services including regulatory and cultural.

In many coastal areas of Japan, sand dunes are a very important element of the "green infrastructure". Sand dunes serve as a kind of bio protective screen that prevents the onset of sand; protects the villages from strong winds and tsunamis.

The Japanese experience is extremely interesting and can be useful for other countries, including Russia, where research in this area has only got started.

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PROBLEMS OF ECOLOGICALLY ORIENTED NATURAL USE ON TRANSITIONAL NATURAL TERRITORIES

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Natural system of the different organization level are able to self-regulation and self-organization in time and space. Such processes result in co-adaptation with formation of integrated systems with different structural-дynamic organization. The adaptation results in appearing of self-organizing systems of higher level with its own functional program. A separate natural system is influences by such components as abiotic, biotic and anthropogenic factors as well as their combinations. The mutual relationship of self-regulating system with surrounding ones is established on the base of obtained information, matter and energy exchange, occasional impacts influence (Armand, 1986). The development of a territory as of environment of formation of a concrete natural system considered as a concrete form of natural use organization is always important. It is especially important when we mean the resources of different environments contact – interzonal, interheight belts, extrazonal, azonal ones reflecting the peculiarities of physical-geographic conditions of a territory in time and space.

The approaches to organization of optimal regimes of involving of territorial resources into economics, which existed not for a long time, such as zoning, division into areas, Territorial Integrated Schemes of Environment Protection, etc. dealt with overwhelming majority of natural use optimization in this or that way. Modern trends in natural use organization determined as environmentally oriented land use planning decrease considerably the set of tasks and simplify approaches for their solution up to the level of determining value and sensibility of natural systems. The evaluation is based the most often on the actual state of this or that level of natural systems organization. However, the evaluation of the date of a concrete system component is based on the data, which often characterize a component for other aims. For example, at forests management, they deal with economic tasks concerning the value of forests by timber stand species composition, their stock in cubic meters for a unit of taxed area. No consideration of environmental conditions of timber stands formation – zonal, height belts, interzonal, interheight belts and other forms of environments contact. Other components included in the forests are indicated from the viewpoint of their presence or absence during taxation period. In this case, a forest is not considered as a system – phytocoenosis, biocoenosis (biogeocoenosis) forming in a concrete environmental zone or at their contact site but as a timber state of a concrete economic value. The intensity of use of a resource, in this case – of a forest, must not exceed maximal rate and destroy the mechanisms of its renewal for concrete conditions of vegetation in a forest (Hummel, Sizykh, 1997). While organizing environmentally oriented natural use at the contact of different environments, it is necessary to consider are natural systems with all its inherent and intersystem links reflecting the peculiarities of its structure, dynamics and functioning. It is always necessary to take into account the following factors: physical-geographic conditions in a region (territory); consequences of forms and regimes of resource use previously; structure and dynamics of natural system with any type of resource usage; analysis of a situation, in which this or that form of resource use was organized from the historical viewpoint; forecast for different periods based on the monitoring.

ECOLOGICAL AND ECONOMIC SITUATION ON THE BORDER TERRITORIES OF THE KNR AND THE SOUTHERN ZONE OF THE 'RUSSIAN FAR EAST

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Cross-border territories have a certain specificity, the integral part of which is the unity, the continuity of the geographical environment, the unity of the links of the economic infrastructure (Hansay, 2004), as well as the unity of the ecological condition of the territories as a result of the functioning of territorial and economic structures. Considering the transboundary territories as a whole, it is necessary to study the border areas, because they concentrate in themselves the results of interaction and mutual influence in various fields. At the regional level, the border areas are separate administrative units. A characteristic cross-border territory is the south of the Far East.

The border regions and counties of the southern regions of the Far (western regions of the Primorsky Territory, the southern territories of the Khabarovsk Territory, the Amur Region and the Autonomous Okrug) and the Heilongjiang Province of the PRC are considered, namely: the natural resource potential and the types of economic activity existing at the given time (Stepanko, 2008).The collected and analyzed material allows us to draw the following conclusions:

1. It is quite obvious that in the adjacent territories of the south of the Far East and Heilongjiang Province of the PRC, two different-sized economies have developed. Heilongjiang province is dominant, which is due to a number of factors: a disproportionately large density and population in comparison with the Russian regions, the presence of a relatively developed transport infrastructure and industrial production, and natural and resource potential.

2. The combined environmental and economic analysis of the neighboring municipal regions of the territories and regions of Russia and the districts of the Heilongjiang Province of the PRC allows us to conclude: economic activity in the border areas of China is more diverse in structure and is more impacting on the natural environment, which means it forms the ecological most actively and intensively situation in cross-border territories.

3. Analysis of measures taken in the field of environmental protection and rational nature management, as well as their economic security in the territory of Heilongjiang, China is much higher than in the territories of the southern zone of the Far East.

Cooperation between Heilongjiang and the south of the Russian Far East is growing every year and has high potential for growth. This is facilitated by geographical, political, economic, socio-cultural and environmental factors. The current practice of substantiating business projects and activities shows that it is still mainly based on criteria of economic efficiency. Narrow criteria of economic efficiency (reduced costs, cost of production, etc.) used to justify the scale of construction lead to an unjustified increase in production capacity. And the absence of the necessary coordinated environmental component (ecological capacity of the territories, the speed and intensity of the utilization of polluting substances by the natural environment, the sustainability of natural systems (which is very different), as well as the inconsistency of interests and actions of bordering states and the presence of differences in environmental management rules and sanitary norms will give rise to new and exacerbate old environmental concerns. Therefore, the priority tasks should be joint projects, developments to unify the rules of environmental management and sanitary standards. It is also imperative for cross-border territories, in addition to economic joint projects, to form and implement joint projects on environmental protection and rational nature management, using the principles of a green economy.

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RUSSIA AND CHINA: COMPARATIVE ANALYSIS OF ECOLOGICAL AND ECONOMIC DEVELOPMENT TRENDS

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Currently, many countries are developing and implementing plans for the transition to a green economy. The key features of green economy are the reduction of environmental pollution and the efficient use of natural resources. China's rapid economic growth causes a high degree of negative impact on the environment, which is most acute in relation to air pollution. China is a leader in the group of the most heavily polluting countries in terms of carbon dioxide emissions (CO_2). Russia ranks fourth in this rating (after China, the United States and India), while the air pollutant emission per capita in our country exceed the levels of many developed countries.

The purpose of this article is to assess the development trends of Russia and China using the colors of growth framework (Victor, 2015). It allows us to characterize the dynamics of development as "green", "brown" or "black" growth (or degrowth) in relation to the consequences of economic activity. Based on World Bank's data (The…, 2020), we will evaluate the development trends of these countries, taking into account resource consumption and environmental pollution. The characteristic of the level of economic development in our study will be GDP based on purchasing power parity (in constant price of 2011). The following ecological and economic indicators are used in the work:

– eco-intensity (amount of CO_2 emissions and wastewater discharges per unit of GDP);

– energy intensity level of primary energy (indicator shows how much energy is used to produce one unit of GDP).

The results of calculations showed that the situation in the Russia is favorable with regard to the discharge of polluted wastewater. In the period from 2001 to 2018, the country demonstrated "green" growth, i.e., against the background of an increase in economic indicators in relation to the base period, there was a decrease in both total and specific environmental pollution. China showed a "brown" growth from 2012 to 2017 (the total volume of wastewater discharges increased, while specific discharges decreased in relation to the base period). The adverse situation in the analyzed countries is noted for CO_2 emissions. In Russia, there was a "brown" growth (with the exception of 2002, which fell into the "green" growth zone). China has only moved into the "brown" zone in recent years. Between 2002 and 2009, as well as in 2011, economic growth was characterized as" black " (i.e., it was accompanied by an increase in both total and specific CO_2 emissions). An analysis of development trends taking into account primary energy consumption showed that both countries had generally "brown" growth. In China, the situation is slightly worse than in the Russia (2004 and 2005 were in the "black" growth zone).

Thus, it can be concluded that in order to transition to a "green" economy, countries need to modernize their existing production facilities, which will increase the efficiency of resource use and reduce the overall negative impact on the environment.

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SESSION 2. «SUSTAINABLE DEVELOPMENT OF THE INTERNAL AND CROSS-BORDER TERRITORIES IN ASIA REGION UNDER GLOBAL CHANGE»

ASSESSMENT OF THE EFFECTIVENESS GOVERNMENT SUPPORT THE LIVESTOCK IN THE TRANSBAIKAL REGION

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Issues of the economy of rural production, a comfortable environment for living in the countryside, as well as conditions for improving well-being and further strengthening the position of the Russian agricultural sector as a modern, global competitive industry are a national task of the state. The main area of activity of the agro-industrial complex is agriculture, the development of which directly depends on the geographical location and climatic conditions. In Russia, agricultural activity has concentrated in the southern and southwestern regions, while the rest of the regions have an average and low share of this sector in their economy. One of the priority goals of the state policy of the Russian Federation is the development of agro-industrial complex in poorly developed regions with an unfavorable investment climate (geographical location, climate, innovation, labor resources, etc.), one of which is Transbaikal region

Transbaikal region occupies 63rd place in terms of agricultural production in the Russian Federation, in actual prices the volume is 22 903.4 million rubles, which is 0.43% of the total output in Russia. In the structure of the domestic regional product of Transbaikal region agriculture occupies only 7.62%. The number of enterprises and agricultural organizations in the region is declining, if in 2013 the number of enterprises was 1001 units, then by 2019 – 843. The average monthly nominal accrued salary of employees of agricultural organizations is 10757.7 rubles or 27% of the average level. The share of the crop production sub-sector in the region is 25.03%, the majority is the livestock sub-sector - 74.97%. At the same time, the production of livestock products tends to decrease, so in the period from 2014 to 2019, the production of the sub-sector decreased by 4.13%, in physical terms.

At the same time as the situation worsens, the industry has measures of state support in the form of regional and federal programs. State programs are aimed at stabilizing agricultural production, increasing the volume of food and beverage production, and increasing the level of profitability of agricultural organizations. Growth in gross output at comparable prices, both in the crop industry and in animal husbandry. To implement these programs, 7.533,8 million rubles were provided. In turn, the financing of the livestock sector in the period 2015-2018. was insignificant – 17.01% of the total funding, while the largest share was in the subprogram "Ensuring the implementation of the state program of Transbaikal region," which amounted to about 35.4%.

Of particular interest are the planned and achieved values of the targets, which draw conclusions on the effectiveness of the implementation of state support measures and, in general, the development of the livestock sub-sector. Analysis of the data showed that the main reason for the satisfactory implementation of the targets was not the growth of production, but their underestimation in the baseline.

There is no active development of the livestock industry, the measures proposed by the Government are not fully implemented in Transbaikal region. The Government should correctly identify priorities, create possible conditions, concentrate resources for development and do so in an active, meaningful process.

MORPHOMETRIC FEATURES OF THE LAKE BAIKAL BASIN

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Analysis of the morphometric parameters of the Lake Baikal basin was carried out (on the territory of the Russian Federation). These parameters indicate the conditions of water starting into river systems (RS) and the possibilities for the formation of thalwegs. The catchment area, the total length of the water-erosion network, the average and maximum altitude of the catchment, the average slope of the catchment and the water surface, the depth of the erosional incision of the channel are determined. Topographic maps of scales 1: 500,000 and 1: 200,000 and radar survey data were used as cartographic material.

Areas uniting river systems are highlighted. These are the RS of the Primorsky ridge, the Baykal'sky ridge, the RS of the Baikal-type depression, the rivers draining the northwestern slopes of the Khamar-Daban and Ulan-Burgasy ridges, the western slopes of the ridge Barguzin and a separate region make up the RS of the Selenga river basin. The sub-basins of the RS of the Khamar-Daban ridge have the smallest areas. The RS of the western slope of the Barguzinsky ridge have similar values. RS of the Baikalsky and Primorsky ridges are also similar in terms of the size of the catchment area. The largest areas of the basin belong to the RS of the Baikal-type depressions and the RS of the Selenga river basin. The smallest areas of elementary watercourses of the 1st order also have the RS of the Khamar-Daban ridge, the maximum areas are the RS of the western slope of the Ulan-Burgasy ridge, as well as the PC of the Baikal-type depressions and the Selenga river basin. The minimum average altitude are confined to the RS sub-basins of the Primorsky and Ulan-Burgasy ridges, the maximum altitude - to the RS basins of the Baykal'sky and Barguzinsky ridges. Elementary watercourses of the 1st and 2nd orders of the Barguzinsky ridge and Baikal-type depression have absolute maximum altitude, and the Primorsky ridge, Ulan-Burgasy ridge and RS of the Selenga river basin have the minimum altitude. The lowest and at the same time the highest slopes of the catchment area and water surface belong to the RS of the Khamar-Daban ridge. The next gradation is occupied by the catchments of the RS of the Baykal'sky Ridge and the RS of the Baikal-type depression. The smallest drainage slopes are of the Selenga river system. The minimum slopes of the water surface in the Selenga river basin. The RS of the Primorsky and Baikalsky ridges, as well as the RS of the Bakal type depressions, have rather high slopes. The rivers of the southwestern coast of Lake Baikal are characterized by high slopes along their entire length, right up to the mouth.

The Selenga river system has the maximum length of the water-erosion network (96% of the total length of the hydro-network of the Lake Baikal basin). 2.5% falls on the RS of the Baikal-type depression and 1.5% is the remaining RS in the basin. The longest elements of the 1st order are of the RS of the Barguzinsky and Baikalsky ridges, the least extended are in the RS of the Khamar-Daban and Ulan-Burgasy ridges. The depth of the erosional incision of the rivers channel of the in the lake Baikal basin is everywhere high. Maximum values of the incision depth in the RS of the Khamar-Daban, Barguzinsky and Baikalsky ridges. The minimum incision depth – of the RS of the Primorsky and Ulan-Burgasy ridges, as well as in the Selenga river basin. The most powerful system of the Selenga River is 9th order. The RS of the Primorsky and Ulan-Burgasy ridges are represented by rivers of the 5th and 6th orders, the Baikal ridge - of the 4-6th order, the ridges of the Barguzinsky 4-5th and the Khamar-Daban – of the 2-5th order, the RS of the Baikal type depression – of the 7-8th order.

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CONCEPTS OF PERSPECTIVE REGIONAL DEVELOPMENT OF REGIONS

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In strategic planning, developing a long-term policy documents development of branches of economy and social sphere of the Russian Federation should take into account the Concept of perspective directions of development of the regions. The priorities of social and economic policy in this period include the area of human development, demographic policy and information and communication technologies. The Institute for regional studies of the Republic of Bashkortostan has identified areas of socio - economic development of the TRANS-Ural region. According to their concept for solving the problems of rural areas: the main condition for sustainable development of rural areas should be considered as improving the efficiency of agricultural production. Self-employment in their own individual household, became one of the outputs from the dead end rural unemployment and so on, Given that the study area TRANS-Ural region of the Republic of Bashkortostan has all the natural and human resources for the development of agronomic field, but also to enhance recreational values. We consider it appropriate strategy for its transformation in the region's tourism and recreation for the population of the Ural - Volga region.

It should be noted that the political and socio-economic transformations in Russia over the past decades, including in the Republic of Bashkortostan and at the same time in the TRANS-Ural region, which transformed the very depths of public life, most affected the country's rural population. As the researchers rightly point out, farms and joint-stock companies, intended to replace collective farms and state farms, from the very beginning proved to be unclaimed and many families were left to fend for themselves, left to survive alone. The destruction of socio - economic relations, the collapse of collective and state farms of the economy, a sharp rise in unemployment and defaults that swept not only the active population of retirees, has led to the fact that those few cooperative and farm households, which formed the first stage of reorganisation of the rural economy, it quickly went bankrupt. Entire villages that depend entirely on just one enterprise, which is in a severe crisis, also suffered from the reform. Self-employment of the population in their individual economy has become one of the ways out of the impasse of rural unemployment, etc. The Institute of regional studies of the Republic of Bashkortostan has determined the directions of socio-economic development of the TRANS-Ural region. According to their concept for solving the problem of rural territories: the main condition for sustainable development of rural territories should be considered to increase the efficiency of agricultural production. There is no doubt that even the most extensive agricultural development activities cannot ensure their effective functioning without infrastructure development. It is necessary to improve the image of the analyzed settlement – this is the creation and dissemination, ensuring public recognition of a positive image of the rural territory. We also need to expand the scope of employment in rural areas and create non-agricultural jobs for harvesting, processing, delivery and transportation of agricultural products. For example, the development of enterprises in the form of individual entrepreneurs in the procurement, processing grain (mill); the reception of livestock population for their further transportation and sale of individual entrepreneurs of the village and not other persons with the purpose of protecting the internal market. Considering that the studied territory of the TRANS-Ural region of the Republic of Bashkortostan has all the natural and labor resources for the development of the agro-sphere, but also for strengthening the recreational value. We consider it expedient to develop a strategy for its transformation into a region of tourism and recreation for the population of the Ural – Volga region.

PROSPECTS FOR SUSTAINABLE DEVELOPMENT OF THE BORDER REGION ON THE EXAMPLE OF THE REPUBLIC OF TUVA

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The problems of sustainable development of territories and macroregions acquired a special character in the 20th century, when, against the backdrop of rapid economic growth, the anthropogenic impact on the environment intensified, resulting in global environmental changes. In this connection, the question arose of revising the development strategy of world civilization, which served as an impetus for the development of the idea of sustainable development.

The term "sustainable development" was widely used in 1987 after the publication of and approval by the UN General Assembly of the report "Our Common Future" by the World Commission on Environment and Development (WCED). More than 30 years have passed since that time, and this concept has not lost its relevance, due to which many countries, including Russia, are actively conducting scientific research aimed at harmonizing the interaction of nature and society.

This fact is indirectly confirmed by the increase in the number of scientific publications on this topic. If we turn to the resources of the largest Russian scientific electronic library – E-library, we will see expected results. Firstly, a lot of papers has been devoted to the problems of sustainable development, at the March 2020 we found more than 93000 publications in total. Secondly, there has been a rapid increase in the interest of researchers in this topic from 1991-2016.

It is considered that the transition to sustainable development of Russia is possible only if a balanced and sustainable development of its regions is ensured. In turn, in the formation of methodological approaches to the study of the problems of sustainable development of individual regions, it is necessary to take into account regional specialization, the structure of economic production and the socio-economic processes taking place in them.

In developing the strategy for sustainable development of the Republic of Tuva, which is a border region, we relied on a systematic approach. This methodology involves the implementation of tasks that contribute to ensuring the best living conditions of a person within the economic capacity of the biosphere, and also allows to describe the region in two main aspects: the current state and possible development paths.

The Republic of Tuva is a border region, and has prospects to become a significant transport and logistics center in the context of enhanced mutually beneficial cooperation with the countries of the North-East Asia. The long-term Strategy for the socio-economic development of the Republic of Tuva until 2030 defines promising transport corridors that can pass through Tuva, to Mongolia and China.

On the one hand, the Republic of Tuva has a rich mineral resource potential, which could be an impetus for the development of industry and processing industries. On the other hand, it is important to pay attention to aspects related to protect of unique natural and recreational resources and the ecology of the region. According to the environmental rating of the Russian regions, Tuva was included in the top five of the most environmentally prosperous.

In this regard, the development of the Sustainable Development Strategy of the Republic of Tuva is one of the priority tasks today, both for scientists and for government. This strategically important Document will help to save the region's unique ecosystem and achieve economic growth through careful environmental management, the development of a "green economy" and the conservation of the traditional economic way of life of the indigenous population.

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THE NATURAL AND SOCIO-ECONOMICAL CURRENT CONDITION AND FUTURE TREND OF URBANIZED TERRITORIES OF SELENGA RIVER CATCHMENT (MONGOLIAN PART)

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The Selenge River basin is the biggest water resource confluence for Baikal Lake which situated in transboudary of Mongolia and Russian Federation. The river originates from headwater tributaries of Delgermurun and Ider Rivers which are located in Mongolian territory. Total catchment area of Baikal Lake is 546 km^2 and Selenge River accounts for 82% of the watershed area of the Baikal Lake and holds an area of around 447.060 km^2. Selenge River's most of the part rests in 67% (299 thousand km2) the territory of Mongolia where 33% (148 thousand km2) rests in Russian territory (Selenge – Baikal atlas, 2019). Researchers conducted joint study for the present social and ecological situations of Selenge river catchment in Mongolian side and developed the report based on the study results. The Selenge river valley compromises industries, infrastructures, crop farming and mining sector development. Moreover, big cities such as Ulaanbaatar, Darkhan and Erdenet city situated in this valley. The natural conditions were determined and assessed by means of stable landscape and anthropogenic processes. In particular, stable landscape potential determined with 8 indicators (Melchenko, 1992) such as very weak, weak, medium, high and very high thus, percentage and square sizes assessed. According to the research study, 66.1% or 240628 hectares of the Selenge River catchment area classified: high and very high for the potential of stable landscape, weak and very weak classifications comprise 20,9% which is 12900 hectares of area. With the purpose of determining the present social and economic situations, we have compiled and integrated statistics of administrations, population dynamic, density, mining, crop farming, infrastructure, pastoral capacity and number of livestock in the catchment area, at the level of "city, province and soums". At last, researchers developed the conclusion by composing sketches. Mongolia has 29 river catchment areas and 10 of them are located in the research zone. Thus, we have compiled social and economic general data of the areas mentioned in above part and concluded the current situation as well. In compliance with the current social studies, it's determined that the catchment area of Tuul River has the largest square (67.5 thous km^2), population (1.5 ml), and density of the population (22.6 km/person).

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AN APPROACH FOR EARLY ASSESSMENT OF NORMAL WATER CONDITIONS ON LAKE BAIKAL FOR LEVEL REGIME REGULATION

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The interim Decree of the Government of the Russian Federation (Decree) No. 1667 of 2017 allows for the possibility of level regime regulation of Lake Baikal in conditions of extreme water content beyond the limits of 456.0–457.0 m PS (Pacific Elevation System) which is established in the Decree No. 234 of 2001 (Bychkov, 2015).

Based on the many options for modeling of Lake Baikal regimes (Abasov, 2017) the authors determined that the guaranteed implementation of the Decree No. 234 is achieved only for 35-90% availability of its useful inflow. When raising the level to the upper limit of the Decree there are risks of flooding significant areas in downstream of the Irkutsk Hydro Power Plant (HPP). According to its project water flow through HPP can reach 6000 m^3/s, but only for a lake level exceeding 457.50 m PS. This is due to the limitation of the capacity of the source in the channel of the Angara River. At the level of Lake Baikal 457.0 m PS the maximum discharge of the Angara River is limited to 4400 m^3/s.

During the operation of Irkutsk HPP (since 1960) the maximum daily flow through it amounted to 4180 m^3/s which caused significant flooding in the downstream with banks erosion of the Angara River. In modern conditions due to the development of coastal areas the flow through HPP are limited to 2800-3200 m^3/s (depending on the water availability on the Irkut River). Starting from these values flooding occurs in the downstream.

In this regard the authors report that the Decree is destructive and creates instability of the entire water management system of the Angara basin. The share of useful inflow into the lake relative to the total inflow into the reservoirs of the Angara HPP cascade is 46-67%. The maximum instability of the water management system occurs during periods of heightened and high water periods, in contrast to low water periods, when flow through Irkutsk HPP are limited by the minimum requirements for water intakes in the downstream (1300 m^3/s).

The Decree No. 1667 is fully consistent with the Decree No. 234 for conditions of normal water content, but does not talk the exact parameters for its determination. This is especially important for an early decision when it is necessary to manage of increased or reduced flow through HPP.

The authors propose an approach for determining the average water indicators in each month which depends on the availability of the total useful inflow from the water year beginning and estimates the probability of Lake Baikal level going beyond the established range. An approach is based on the allocation of a subset of hydrographs (according to accumulated statistics from 1899) which are similar to the current date with the calculation of the probabilities of continuation for each of them. Probabilities are specified on the basis of long-term prognostic estimates of the useful inflow into Lake Baikal.

Significant climatic and hydrological changes in the basin of Lake Baikal (for example, the annual rate of useful inflow from 1996 to 2019 decreased by 10-12% in combination with an increase in the average annual temperature by 1-2 °C) cause additional risks of legislative consolidation of the normative range of lake regulation within 456.0-457.0 m PS.

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VARIANTS FOR EXPORTING WATER OF ASIAN RUSSIA: OPPORTUNITIES AND DIFFICULTIES

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Given the increasing global water shortage, the rich water resources of Asian Russia should be considered as its strategic economic and environmental advantage. In a few decades, water can become the most valuable resource of mankind, and Siberian and Far Eastern water resources – an important factor that largely determines the prospects for economic development of eastern Russia and international cooperation with its closest neighbors (China, Mongolia, Kazakhstan and Central Asia). It is advisable, on a strict scientific basis, to consider the prospects of using these most valuable resources of Asian Russia to solve the water problem of the world community.

An assessment of the advantages and difficulties of implementing three options for their export to neighboring countries is presented – water transfer through canals and pipelines, water transportation by large-capacity water-carriers tankers which can withdraw the water from the mouths of large rivers and coastal underground water deposits, bottled water production and sale in foreign markets. As for the first option – water supply from Lake Baikal via a pipeline to Northern China – the volume of rational water withdrawal was determined, but it was assumed that the water quality will deteriorate when it is transported to such a long distance. Favorable factors for transporting water from the mouths of large rivers include the low cost of transportation, minimum degree of impact on rivers, and unlimited volumes of water withdrawal; unfavorable factors are seasonality of navigation, shallow water mouths, economic inefficiency of operating a large number of tankers. What is more efficient if the use of coastal groundwater deposits, however, the possible volumes of water withdrawal are relatively small. The prospects for the implementation of the third option, primarily the production of bottled water of Lake Baikal, are restrained by the natural shortage of many trace elements in this water and the increased transportation costs for marketing, as well as the huge competition in the international bottled water market.

In modern scientific literature, much attention is paid to the another main direction of the international trade of water – the production and marketing of water-intensive products ("virtual" water). Available forecasts for the level of 2030 indicate an increase in the trade in "virtual" water and the economic efficiency of its movement between countries compared with the transportation of water in kind ("real" water). It is believed that for Russia and its eastern regions it may turn out to be beneficial to export water-intensive agricultural products, chemical industry (for example, polymer synthesis products), non-ferrous and ferrous metallurgy, pulp and paper industry, thermal and nuclear energy (subsequently hydrogen energy).

Another advantage of trading "virtual" rather than "real" water through pipelines is that it excludes the political factor of a strict dependence of the exporter (Russia) on the conditions dictated by the only buyer/importer of water (China). Diversified water-intensive and energy-intensive products with high added value will be competitive in the markets of many countries of the world – only then the rich water resources of eastern Russia will truly become its key strategic resources. Nevertheless, given the indispensability of water for household and drinking needs of the population, it is possible to implement options for exporting "real" water, which will be determined by a change in the structure of the world economy and, first of all, economic complexes of neighboring countries, an increase in the deficit of clean water, the conjuncture of its regional markets, etc.

THE TRANS-SIBERIAN TRANSPORT CORRIDOR AND DEVELOPMENT OF URBAN AGGLOMERATIONS

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When discussing the geographical features inthe formation of the framework of the economy, population distribution and nature management of Russia (Siberia) and Mongolia in conditions of the landlocked location and an enhancement in Eurasian integration processes, it is necessary to capitalize primarily on the national priorities of Russia (and on the interests of its eastern regions), with due regard for the interests of neighboring countries. The territories adjacent to the Trans-Siberian Railway (Transsib) lie within the main belt of settlement of Russia and have favorable opportunities for implementation of major transport projects as well as for general economic growth. Such opportunities include: relatively comfortable natural and economic conditions; a comparatively high degree of development and settlement; a rather well-developed agriculture; the advantageous transport-geographical location along the main latitudinal polyroute of the country; large reserves of natural resources; powerful bases of construction industry, and numerous urban settlements.

The settlement system in the zone of Transsib is well developed when compared with the other territories; it is the home for major Siberian centers concentrating the population, modern production facilities and innovation sectors and carries out the transit functions and management of the Siberian regions. The migration redistribution of the population is effected strictly for the benefit of the regional centers, with a constant emphasis being placed on million-strong cities: Novosibirsk and Krasnoyarsk as well as on Tyumen. There is an ongoing concentration of the population and most of the highly-paid kinds of activity in the regional centers.

The competitive advantages and possibilities of the cities and agglomerations will look different if they are regarded not as separate entities but as forming part of a common Trans-Siberian economic space. There are a number of certain risks related to the creation of the international transport corridor on the basis of Transsib. There is no international consistency with respect to the projects and routes in the creation of a global infrastructure of Eurasia. There is a need to develop an optimal scheme of interaction of Transsib and the variants of the Silk Road. To increase transport performance and economic competitiveness of Transsib requires its radical modernization. Non-transport effects are inadequately assessed, which encourage the economic activities in the zones of influence of the transcontinental corridors. Russia, Mongolia and other countries do not have a clear strategy directed toward ensuring parity conditions of interaction. An enhancement in the role of the transport hubs, such as Tyumen, Omsk, Novosibirsk, Krasnoyarsk, Irkutsk, Ulan-Ude and others, objectively leads to the growth of the respective agglomerations and is detrimental to the functioning of the other urban settlements along Transsib which are associated with the railroad.

The Trans-Siberian transport corridor should become the belt of economic development of the adjacent landlocked territories and work for integration of the vast Eurasian space thereby unleashing the potential of the urban agglomerations of Siberia.

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ROADSIDE INFRASTRUCTURE AS CIRCUMSTANCE FOR TERRITORIAL SUSTAINABLE DEVELOPMENT

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The roadside infrastructure in Russia began to emerge recently and has a lot of various problems: lack of filling stations on the road, as well as lack of diagnostics, repair and maintenance services, catering services, hotel, information services, trade, communication services, etc. At present many services, including personal services, leisure, car hire, information, health care, communication services aimed at providing proper rest for drivers and passengers are not sufficiently developed. The relevance of our study is characterized by the lack of theoretical and practical researches in this field in Russia, lack of general concepts for development roadside infrastructure and facilities scheme layouts, as well as lack of consistent information support for management optimization. This paper is one of the first studies in Irkutsk oblast and the accumulated material is the basis for territorial sustainable development. The paper contains results of roadside infrastructure survey in Irkutsk oblast carried out by the authors. In this study, we used systemic and integrated approaches, cartographic research methods, methods of geographic information mapping and spatial analysis. Based on the results of our research, a GIS was created based on the MapInfo software product - a convenient and powerful tool for working with spatial data and creating cartographic works.

However, there are the major concerns of roadside infrastructure development: uneven placement of roadside infrastructure facilities; low level of service and lack of appropriate qualifications of roadside infrastructure workers; there is no integrated database of roadside infrastructure facilities and so on.

As a result, we made the following conclusions:

1) Lack of information on roadside infrastructure facilities, their location and types of services has a negative effect on development and management. Therefore we developed schemes of roadside infrastructure facilities placement for 36 municipalities of Irkutsk oblast using territorial planning schemes as municipality's basic planning document.

2) The major factors and problems of roadside infrastructure development were revealed and mathematical calculations and thematic maps were made. We created a geoinformation system of roadside infrastructure in Irkutsk oblast, which acts primarily as a tool for spatial analysis and a means of displaying thematic maps, providing great opportunities for optimizing the existing network of roadside infrastructure and rational placement of its new facilities.

3) Roadside infrastructure in Irkutsk oblast and in all Russian regions is underdeveloped. In general, regions need gradual modernization of filling stations and complexes network as well as of roadside infrastructure facilities, founding multifunctional complexes on transit highways that would offer a wide range of high quality roadside services and sell different types of motor fuel. This is the only chance for today to survive an independent filling station. At the same time, it is advisable to use existing approaches of developed countries as a guideline for the formation of roadside infrastructure objects.

4) Location of facilities in towns and on highways must be carried out in strict accordance with legislation and urban planning documentation. Special attention is to be given to facilities located in the territory of specially protected natural areas, their construction and reconstruction must be carried out in accordance with environmental protection legislation. First of all, due to the weak legislative base, roadside infrastructure in Russia, as well as in Irkutsk oblast develops very slowly. Even by the small number of laws that govern the roadside infrastructure of Russia, we can judge the weak development of this industry.

DEGLOBALIZATION TRENDS: POSSIBLE MANIFESTATIONS IN THE EASTERN MACROREGIONS OF THE RUSSIAN FEDERATION

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In modern controversy, the grounds for the hypothesis are strengthened, according to which the socio-economic and geopolitical position of the eastern macro-regions of the Russian Federation should be considered not only in the context of globalization, but also in the context of a competing tendency of deglobalization. Deglobalization entails the strengthening of the role of a number of states geographically close to the eastern macro-regions of the Russian Federation, which creates additional opportunities for socio-economic development and cooperation, as well as geopolitical risks. Social and economic cooperation can be expressed in the creation of closer ties both between macro-regions and with neighboring states, the accelerated development of underdeveloped spaces of the eastern macro-regions of Russia. Negative consequences can be expressed in increased pressure of some geopolitical actors on Siberia and the Far East. These geopolitical actors are the United States, China, Japan and Turkey. The expansion on the part of the USA can be expressed in economic penetration, support for the liberal opposition, the ideological trends of the liberal circle, and on the part of Japan, in economic penetration. From Turkey it is possible to support ethnic pan-Turkic movements. On the part of all these countries - in supporting macro-regional and ethnic separatism.

The rise of statism in the modern world, in particular in Russia, that is, the tendency to increase the importance of the state level of governance (one of the aspects of de-globalization), will lead to a weakening perception of each macro-region as a self-sufficient, with a special subjectivity, education.

The modern territorial structure of the distribution of levels of development violates the continuity of the socio-economic space of the Russian Federation and contributes to separate trends in the Far East and in Western and Eastern Siberia. The accelerated development of the eastern macro-regions of the Russian Federation, the elimination of their lag in many indicators of the state of the economy and quality of life, is a necessary prerequisite for maintaining the integrity of the socio-economic and geopolitical space of the state.

We list some of the phenomena of modernity, which in fact have an anti-globalist meaning.

1. Strengthening government regulation of the economy during the 2007 economic crisis
2. Protectionist and anti-migrant trends in the United States during the presidency of D. Trump. Anti-Migrant Performances in Europe.
3. Brexit, a tendency to strengthen the consolidation of the Anglo-Saxon world.
4. Sprouts of dedollarization of the global economy.
5. Strengthening the trend towards the creation of the armed forces of Western Europe (in addition to NATO, therefore, without the United States).
6. Strengthening new (or reviving old) centers of world-class military-political and economic power (China, Japan, Germany, India, Turkey, Brazil). Increased military capabilities of a number of countries claiming to be regional leaders.
7. Sanctions of the West against Russia (we emphasize not the aspect of hostility, but the fact that sanctions are state intervention in the economy).

Not all of these trends are directly related to the Siberian and Far Eastern issues, but, nevertheless, they are all interconnected, are parts of a single phenomenon.

ROLE OF INNOVATIONS FOR ECONOMY FORMING OF RESOURCE REGIONS

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Geographical environment is material basis for outpacing socio-economic innovative development of regions and increase of population life quality. Russian regions with traditional resource orientation of their economy are area of particular interest. In a certain sense, their production method and economic mode freeze realization of investment and innovation processes. Also they are depended from external conditions. Appearance of internal social and technological innovations is directly related to effect of self-development on the basis of traditional activity. Geographical environment is considered as unity of natural, social and economic conditions.

Analysis of region development peculiarities is based on comparative theoretical-mathematical approaches and models using investment and production statistic data. These models take into account environmental factors and explain how they affect investment process, economic cycles, stable and active states of regional economy, and reveal geographical and historical definition of socio-economic situations and development trends. The models describe regional economic changes with stagnated (trivial equation solution) or innovation character (nontrivial solution). Nontrivial solutions include time variable and therefore velocity of progressive development that characterizes innovation component of regional economy. Territorial organization of society is considered as an example of this phenomenon. It arises on the basis of infrastructure networks of geographical environment and forms clusters of innovation development. It makes sectoral economic complexes which are attached to local conditions and take the region out from traditional resource economic activity mode to a new stage of progressive development. Conditional economic age of different Russian regions is calculated.

There are two general groups: 1) East-Siberian and Far Eastern regions with young resource oriented economy, 2) West-Siberian and Western regions with more mature economy. The economic age is connected with the recourse specialization and self-development potential of economy.

Analysis reveals that geographical determinacy provides stable existence of a region but not its sustainable development. Constant external investment flow or favorable investment conditions inside the region with innovation conditions is necessary. The model allows to define quantitatively socio-economic indicators which characterize transition from the traditional cycle of resource economy to a new development stage based on internal innovation potential.

DEVELOPMENT OF ECOLOGICAL TOURISM: RUSSIA AND CHINA

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Innovative development of the Russian economy, when the country experiences EU and US sanctions, requires a deep study of domestic and foreign tourism experience (Dayneko, 2018). After studying many modern sources about tourism, the authors came to the conclusion that ecotourism should be an important component of the socio-economic development of Russia, China and North-East Asia, which is able to preserve their natural, historical and cultural values. Ecotourism is a relatively new concept in Russia and in China. A distinctive difference of ecological tourism from regular tourism is that mass tourism means simply traveling a distance from home, while ecotourism is defined as responsible travel to natural areas that promotes the protection of nature and supports the well-being of the local population and includes interpretation and education. The International Ecotourism Society (TIES) defines ecotourism as a system of travel and tourism that promotes environmental conservation by educating travelers about sustainable lifestyles (TIES, 2020). According to statistics provided by the World Tourism Organization (UNWTO), ecotourism accounts for about 12-15% of all tourist flows. Moreover, the number of eco-tourists increases by 25-30% annually. It is expected that the share of Russian and Chinese tourists in the total number of ecotourists will also increase.

Russia and China have great recreational resources that are studied and used further for ecological tourism purposes. Our countries have many specially protected natural areas (SPNAs) which have the world fame and are of interest to both tourists and local residents, especially those who are interested in wildlife. It is the wealth of natural resources that determines the conditions favorable for the development of eco-tourism and its forms in our countries. It is worth to mention that the peculiarity of Chinese and Russian attractions is not only in their diversity and scale, but is in their geographical location with considerable distance from each other too. The basis of ecotourism in Russia and China are SPNAs, which include nature reserves, national and natural parks, State reserves, natural monuments, dendrological parks and botanical gardens, health-improving areas and resorts, and territories of traditional nature usage.

Many SPNAs are included in the UNESCO world heritage list. And some of them, such as, for example, lake Baikal, are under the threat of extinction. In total, there are 11 World natural heritage sites on the territory of the Russian Federation, which include: 13 nature reserves, seven national parks, three Federal reserves, several natural monuments and buffer zones of nature reserves. There are 105 State nature reserves, 52 national parks, 57 Federal reserves, 17 natural monuments, and 67 botanical gardens, which have been created in Russia(TASS, 2018).The total area of Federal protected areas is 63.3 million hectares, and together with regional territories, the area of protected areas in Russia is 209.5 million hectares.

China has become one of the most popular travel destination in the world too. The UNWTO World Tourism Rankings rank China as the third most visited country in the world. The Chinese Ministry of Environmental Protection or the MEP stated that there are 2.541 nature reserves covering 147 million hectares or 14.7% of China. 80% of these reserves have some form of ecotourism. With its rich natural landscape and features, China has beautiful natural scenery tourists are thirsty for (Thibaud, 2016).

The result of eco-tourism activities in our countries is to attract the resources for the development of tourism and the economy of the regions in which they are located. Therefore, the importance of ecotourism in our countries is currently highly relevant. This type of tourism plays a significant role in preserving the unique natural, cultural and historical heritage used for tourism purposes. It attracts a huge number of tourists and is thus profitable from an economic, social and political points of view.

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INTERREGIONAL MANAGEMENT OF LAKE TAHOE WATERSHED AREA CASE AS AN EXAMPLE FOR THE BAIKAL NATURAL TERRITORY MANAGEMENT

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The need for sustainable development has become clear to all humanity, especially with the acceleration of global warming. Solving the accumulated environmental problems on a global scale requires the most complex effort coordination of many parties, which makes it impossible to achieve success in the near future. The complexity of solving global problems also lies in the difficulty of understanding them, because often the consequences of human activity are not obvious or their effect can be detected at a remote distance (as in the case of pollution of the world's oceans with plastic waste). In such a situation, regional ecosystems that are more or less limited in space seem to be an excellent "training ground" for processing possible joint measures to solve problems that hinder sustainable development. It may seem that a smaller territorial coverage allows us to quickly understand the cause of disastrous changes in the state of the environment (as well as to see the economic consequences of inaction or erroneous decisions faster), and a smaller number of actors allows us to make decisions without excessively long discussions. However, it can be stated with great regret that the most obvious examples of such relatively closed ecosystems do not allow us to talk about the ease of solving their environmental problems.

The catchment area of Lake Baikal is located in three regions of the Russian Federation, as well as on the territory of Mongolia. For several years now, discussions have been ongoing on the plans of the Mongolian Government to build hydroelectric power stations on the tributaries of the lake, which are predictably opposed in Russia. At the same time, with the growth of tourist flows, the existing environmental problems of the coast have significantly aggravated uncontrolled development, lack of treatment facilities in settlements, undeveloped social infrastructure, etc. Besides, the problem of eliminating accumulated waste from the activities of closed Baikal Pulp and Paper Mill, which in the event of mudflows from the nearby mountain slopes could lead to an environmental disaster, has not been resolved. However, even a dramatic deterioration of the situation, clearly expressed in the clogging of coastal waters with algae, uncharacteristic of the lake (which in some places not only changed the color of the waters but also led to the appearance of a sharp unpleasant odor), was not a sufficient reason for increased coordination even of two coastal regions. The Federal Government is trying to solve the accumulated problems through tightening control and a new initiative to introduce direct federal management of the territory, which may lead to at least a long-term delay related to organizational issues.

In my opinion, the experience of interregional management of the Lake Tahoe watershed, located in the states of California and Nevada, is much more acceptable for solving similar problems. The rapid growth of tourism and construction on the coast, accompanied by the development of gambling industry, could culminate in the construction of a large city and multi-lane highways along the shores of the lake. However, opposition from environmental activists and regional politicians' awareness of their responsibility led to the signing of a bi-state Compact that created a regional planning agency to oversee development at Lake Tahoe. The signed bi-state Compact in 1969 was ratified by the US Congress, which became a precedent case in the country. Subsequently, California and Nevada several times supplemented and changed the approved agreement to establish new goals in the management of the joint territory. An example of successful solutions to the most pressing environmental problems of Lake Tahoe shows the power of real federalism, which can unite independent actors with the support of federal government. I would like to believe that this model would serve as an example not only for management in the Baikal region but also for solving global problems of humanity.

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THE REORIENTATION OF RUSSIAN EXPORTS: OPPORTUNITIES AND PROSPECTS

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One of the main features of the Russian economy is its export orientation. Oil and refined products, natural gas, coal, wood, ores and metals for many decades have remained the main export products. Exports of other goods and services, except for grain and military-industrial complex products, do not generate significant foreign exchange earnings. The high importance of exports determines the importance of transport infrastructure, the development of which directly affects the possibility of profitable sales of products on world markets. However, despite the direct border with the world's largest markets: the European Union and the people's Republic of China, as well as long coastline, the weak development of transport infrastructure remains a limiting factor for Russian exports, as it has been almost throughout history. In recent years, the Russian government has made many efforts to eliminate such limiting factors, but global trends may make all these attempts futile in the near future.

The political factor became one of the main obstacles to the growth of Russian exports after the collapse of the USSR. Seaports and transit oil and gas pipelines remained on the territory of the newly independent states, some of which immediately began to pursue policies unfriendly to the former metropolis (Estonia, Latvia and Lithuania), while relations with others deteriorated much later. Constant interstate disputes over cargo transit with newly independent states have led the Russian Government actively investing in the development of seaports on its Baltic coast, as well as creating a new export pipeline infrastructure to bypass some of the transit countries. Some of the implemented initiatives were completed and resulted in a significant increase in exports through Russian seaports (with a simultaneous decrease in exports through the ports of the Baltic states). However, the escalating political situation and constantly increasing economic sanctions related to the conflict between Russia and Ukraine resulted in the fact that projects such as the construction of the 'Nord stream-2' gas pipeline have not yet been completed.

Significantly increased competition in the traditional Russian export markets of oil and gas has become a new reality for the country's economy. Previously ignored by state-owned Gazprom and Rosneft, shale developments in the United States, as well as the spread of liquefied natural gas (LNG) supplies in Europe as an alternative to pipeline gas, have considerably reduced energy prices. The long lag in the export of liquefied natural gas was decided to overcome through the development of LNG projects on Sakhalin and Yamal, but it quickly became apparent that this created additional competition for state-owned Gazprom in the previously monopolized export market of the country.

Nevertheless, global climate warming may be an even greater threat to Russian exports. Reduced fuel demand due to warm winters in Europe, as well as the widespread adoption of higher environmental standards in the European Union, has led to a higher share of renewable energy in total production. Demand for Russian energy coal has also fallen sharply in Europe, making the previously most important export market less dependent on Russian supplies.

Russia expects to increase the supply of coal and other resources to Asian markets, for which it is actively investing in expanding the Trans-Siberian Railway's carrying capacity and building oil and gas pipelines in the East of the country. It is also planned to develop the Northern Sea route to stimulate the growth of transit supplies through the Russian territory. However, this does not guarantee the preservation of export opportunities, as well as the economic development of transit regions.

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THE SOCIO-ECONOMIC AND GEOPOLITICAL FACTORS OF NATURE MANAGEMENT SYSTEMS TRANSFORMATION IN THE MOUNTAINOUS REGIONS OF SOUTHERN SIBERIA

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The territory under consideration covers the Russian part of the Altai-Sayan mountain country. It entirely includes the territories of the republics of Altai, Tyva, Khakassia, the southern parts of the Altai krai and Krasnoyarsk krai, the Kemerovo and Irkutsk oblast, and the Western part of the Republic of Buryatia. The territory is characterized by a border position, high landscape and ethno-cultural diversity, significant natural resource potential.

In the Southern and South-Eastern parts of the study territory, the population is dominated by Turkic-speaking (Altaians, Khakas, Shors, Tuvans, etc.) and Mongolian-speaking (Buryats) peoples. They are characterized by traditional types of nature management systems based on semi-nomadic animal husbandry as well as hunting and gathering. During the Soviet period, when the planned economy prevailed, the entire population of the region was transferred to a settled lifestyle, and its economy was organized into large enterprises-collective farms, state farms, and logging enterprises. In the North and North-West of the region, the Russian population predominates, which is characterized by a high degree of innovation in nature management. During the socialist development of the economy, large agricultural and industrial enterprises appeared here – power stations, mines, logging and timber processing enterprises.

Abolition of large enterprises. After the collapse of the USSR in 1991, most large enterprises ceased to exist. There were many landowners who, however, did not have the material resources to conduct a highly efficient commodity economy on an intensive basis. Gradually, a return to extensive but low-cost traditional forms of nature management began. Owners of land shares and small herds began to unite in public (often family-related) brigades for the purpose of joint economic activity. Also, in the conditions of an open market and the rupture of economic ties that developed in the USSR, numerous industrial enterprises went bankrupt. Obviously, the main reason for this was the huge costs determined by the natural conditions of this territory, its weak infrastructure development, as well as low labor productivity, which in Soviet times was covered by the state.

The emergence of new types of economic activity. In the post-Soviet period, new types of nature management began to develop here. For example, tourist and recreational economy. The mountains of Southern Siberia are currently considered as one of the main regions of development of the tourism industry in the Russia. Two of the seven Federal Special Economic Zones of tourist and recreational type and one of the four Russian gambling zones have been created here. Medical and ski tourism is actively developing.

Geopolitical and geo-economic shifts in the global and macro-regional order also have a significant transformative impact on nature management systems. Vectors of interstate interaction between Russia and China, Kazakhstan and Mongolia can determine the role of the regions of southern Siberia as a territory of active cross-border cooperation or as an impenetrable barrier. Currently, a gas pipeline and a road to China via Altai Republic are being built. In the future, it is planned to create a railway that will connect "two mainland transport bridges": the Trans-Siberian railway and the Eurasian railway. Improving the transport accessibility of the regions of Southern Siberia can significantly change the specialization and technologies of nature management, as it will allow you to sell products in fairly remote markets, as well as use their territory and resources to provide services (for example, tourist) to the population of other regions and countries.

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THE DIFFERENTIATION OF DEMOGRAPHIC BURDEN COEFFICIENTS ON THE TERRITORY OF IRKUTSK REGION

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One of the most important indicators of socio-economical potential of the territory is coefficient of general demographic burden. This coefficient is equal to the ratio of disabled aged population: children (under 15 years old) and people above working age (women after 55 and men after 60 years old) to the population of working age (per 1 thousand people).

The data of statistic base of Federal state statistics service for urban districts and municipal districts of Irkutsk Region has been used in the research.

Up to 01.01.2020 general demographic burden in Irkutsk Region was 821 (per 1 thousand), this index has increased by 19.5 % since 2000 (661 per 1 thousand). In 2000 the value of general demographic burden was positive as the burden of children was 27 % higher than the burden of retired aged people. In 2009 the value of general demographic burden became negative, because the burden of retired aged people (296) was higher than the burden of children (295 per 1 thousand). Nowadays the value of general demographic burden is negative – the burden of retired people (421) is higher than the burden of children (400 per 1 thousand people).

The analysis of coefficients of general demographic burden values in terms of municipalities has shown: in urban districts the coefficient varies from 707 per 1 thousand (Irkutsk) to 1069 (Svirsk); in municipal districts – from 719 (Irkutsk district) to 1114 (Kachug district). The groups of territories have been distinguished according to the value of demographic burden coefficient. Two urban districts – Irkutsk, Bratsk, and Irkutsk municipal district belong to the first group with minimal value of the coefficient – less than 800 (per 1 thousand). Irkutsk as the regional center has the main value in this group, the part of employable population in Irkutsk is the highest in the region – 59 %. 26 % of population of the region are concentrated in Irkutsk, what greatly influences the overall regional index of coefficient general demographic burden. The amount of population of the first group compounds 42 % of the region population.

Most of municipalities form the second group with average values of the coefficient from 800 to 1000: 7 urban districts and 24 municipal districts. 52% of population lives on these territories.

The third group of territories with maximal demographic burden over 1000 compounds urban district Svirsk and 7 municipal districts: Zhigalovsky, Zalarinsky, Kachugsky, Kirensky, Ust-Udinsky, Mamsko-Chuisky and Bayandaevsky. In these districts high coefficients of burden are observed according to excess of disabled aged population over population of working age, the percentage of working age population is under 50 %.

Thus, on the territory of Irkutsk Region significant differentiation of coefficients of general demographic burden is observed. Average values of general burdens are typical for 50 % of population. Maximal values of burden have been revealed in northern districts (due to high pension burden) and in districts of middle area settlements with high values of potential burden (children).

The research has been performed in accordance with the plans of research work V.B. Sochava Institute of Geography SB RAS from funds of state assignment with the topic: "Socio-Geographical factors of ecological-economical transformations in Siberian regions from the position of stable development" (№ - AAAA-A19-119122490007-4; project № 0347-2019-0006).

SOCIAL, ECONOMIC AND ECOLOGICAL CHARACTERISTICS OF SUBURBANIZATION DEVELOPMENT

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This study is devoted to the suburbanization as an important stage of agglomeration development. Foreign research into suburbanization has almost a century-old tradition in North America, with long-term investigations made into West-European and African cities. In Russia, however, the degree of previous study on these themes is negligibly low and very few regional investigations on this problem have been carried out to date. Therefore, the current relevance of the topic presented remains beyond any doubt. The novelty of this research implies that suburbanization is regarded as one of the main trends in the development of the settlement structure of the Irkutsk agglomeration and a new way of life of a large peripheral city. This study permitted us to identify specific features of suburbanization in the Irkutsk agglomeration. The main trends in suburban development are determined, which are due to the economic, social and ecological factors. Of particular importance in this investigation are mapping and geoinformation methods which have great potential for integral real-time presentation and analysis of the suburbanization process. For this purpose, a series of maps displaying different aspects of the study territory (change in population size, dynamics of construction, etc.) has been compiled. We identified five groups of municipalities of the Irkutsk agglomeration according to the development factors of the territory. The findings indicate a sufficiently dynamic process of change in the suburban territory of the Irkutsk agglomeration. The main conclusions are of great practical significance for administrative bodies considering that the development of the network of suburban settlements and its delimitation are most relevant to date.

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TOURIST-RECREATIONAL ZONING OF TERRITORIES WITH SPECIAL TERMS OF USE

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Special conditions for the territory use are determined by a specific legal regime established due to location of objects on it that have an important natural, historical, cultural, engineering, and technical or other value. Tourism needs to be expanded in its space, but inevitably is emergence of situations requiring a clearly formulated and reasonable approach to the territorial organization of tourist and recreational activities, taking into account existing environmental restrictions. The Central Ecological Zone of the Baikal Natural Territory (CEZ BNT) is characterized by a combination of restrictions for the development of tourist and recreational activities aimed at preserving the unique ecosystem of Lake Baikal as a whole, and individual components of natural and cultural environment. Tourism in the CEZ BNP is perceived as determining further socio-economic development and the most environmentally tolerant type of economic activity. Developed is a conceptual framework for assessing the potential of tourist development of a territory, taking into account its economic functions (by land categories) and real recreational use. Areas with high potential for tourism development include areas with a direct purpose for organization of tourism and recreation, including plots on specially protected territories and on lands of recreational facilities, territories where, in accordance with the legislation, certain types of recreational activities can be combined with basic economic functions under certain conditions (plots on forest lands allocated for forest recreation, territories of national parks, allocated by their own functional zoning for ecological tourism). The proposed algorithm of tourist and recreational zoning is implemented for the CEZ BNT in Republic of Buryatia and the Irkutsk region. Based on the analysis of the existing legislative and legal conditions, taking into account the modern use of the territory of the CEZ BNT, the territories have been allocated for which tourism is proposed as a priority direction of development. The presented results imply further actions on their inclusion in the urban planning and program documents with the subsequent detalization of the territorial structure of tourism and regular monitoring of environmental, social and economic development parameters.

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ASSESSMENT AND REGULATION OF RECREATIONAL LOADS ON THE SOCIAL ENVIRONMENT ON THE EXAMPLE OF THE COAST OF LAKE BAIKAL

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The topic of recreational loads is currently relevant. The assessment and regulation of recreational loads is becoming a kind of requirement of the time. With the assessment of the ratio of environmental, social and economic priorities, the adoption of design decisions for the development and use of recreational resources is associated.

In many countries, authorities are beginning to restrict or completely block access to tourists from visiting the most famous natural and cultural attractions. The reason for such harsh measures is the accumulation of negative effects that arise when tourist areas reach their maximum recreational capacity.

The problem of social loads from recreational activities in places where the local population lives is particularly relevant. The intensification of tourist activity in the territories where the local population lives, entails a burden on the social environment and requires solving a number of problems arising in this connection. The social environment in this context means the local population and the social infrastructure.

A typological approach to the assessment and regulation of recreational loads on the social environment is proposed. The typological approach, based on the differentiation of recreational areas by the level of social load, makes it possible to distinguish the types of areas, regulate the recreational load on the social environment and make adjustments to the relevant documents for the development of tourism in specific areas.

The assessment of the load on the social environment caused by the growth of tourist flows to popular recreation sites was carried out using the example of the central ecological zone of the Baikal natural territory (CEZ BNT). To assess the recreational load on the social environment of settlements, the optimal ratio of the number of tourists and permanent residents, close to 1: 3 (0.3), was taken into account.

The lump sum of tourists during the high season was accounted for based on activity data for all types of collective accommodation. The population size in coastal settlements corresponded to the Rosstat data available at the time of the study (2016, 2017).

On the coast of the lake Baikal have been identified five types of territories according to the level of social burden. For each of the types, the necessary measures have been formulated aimed at the formation of a balanced tourist and recreational environment in the ecological, economic and social respect.

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INVESTMENTS IN FIXED CAPITAL AND PROSPECTS FOR SUSTAINABLE DEVELOPMENT FOR THE EASTERN BORDER REGIONS OF RUSSIA

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The purpose of this study is to assess the economic effects generated by investments in the economy of the eastern border regions of the Russian Federation, involved in cross-border cooperation with Asia-Pacific countries. The economic indicators for 2011-2018 are analyzed in the following eastern regions of the Russian Federation: Amur, Irkutsk, Magadan and Sakhalin Regions, Jewish Autonomous Region (Jewish AR), Republics of Buryatia and Sakha (Yakutia), Transbaikal, Kamchatka, Primoryeand Khabarovsk Territories, Chukotka Autonomous Area (Chukotka AA).

The Irkutsk and Sakhalin regions, the Republic of Sakha (Yakutia)are the real leaders among the considered regions in terms of investment in fixed capital (FC) and gross regional product (GRP) for the period 2011-2018.

Positive dynamics of GRP and investment in FC growth for this period is observed only in two regions of this group – in the Irkutsk region and the Republic of Sakha (Yakutia). Nevertheless, the growth in investment in FC among this region group in 2018 in relation to 2011 ranged from – 66.9% (Primorye Territory) to 67.0% (Magadan Region); in Russia as a whole it amounted to 4%. At the same time, the GRP increase over the same period varies from –11.2% (Jewish AR) to 27.3% (Irkutsk Region), and in Russia as a whole it is 11.5%. However, in most of the examined regions, the share of investments in FC aimed at reconstruction and modernization is 5-20%, which causes some concern.

In the sectoral investment structure in almost all the examined regions the Mining, Manufacturing and Construction investments occupy a significant place. In 2018, in 5 subjects of the group, their total volume exceeds 52% of the total investment in FC. An insignificant share of investments in these sectors (20-26%) is observed in Kamchatka, Primorye and Khabarovsk territories, the minimum is in the Jewish AR (13% in total). In addition, during the period under review, structural changes in the sectoral investment distribution were revealed in all regions of the group: the share of investments allocated to these economic activities increased markedly. Significant increase in investments in Mining are observed in Primorye (6 times) and Trans-Baikal (3 times) territories, in Manufacturing – in Amur region (105 times) and Primorye Territory (6 times), Construction – in Sakhalin region (12 times), Jewish AR (10 times) and Kamchatka Territory(5 times).

With regard to GRP, among the considered regions during this period, such impressive changes are observed only in the Mining: in the Jewish AR its share grew 25 times, while in the Irkutsk Region and Trans-Baikal Territory they grew 1.9 and 2.4 times.

The correlation analysis revealed the close nature of the relationship between investments in FC and GRP both in the regional economy as a whole and in individual economic activities (Construction, Mining, Manufacturing) throughout the ensemble of regions.

Analysis of investment flows and indicators of socio-economic development of the eastern border regions of the Russian Federation allows us to confirm the conclusion that the existing institutional environment does not yet ensure sustainable economic development of the East of Russia.

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SIGNIFICANCE OF ECONOMIC BELT SILK ROAD FOR IRKUTSK REGION

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It's been over 6 years since it was pronounced from the moment of declaration of Economic Belt Silk road, but russian position is not convincible yet. The main issue of this report is what is the significance of economics belt Silk road for regional development of Irkutsk region. The three main moves presented in the document, justified by the concept, bypass Siberia, passing through the south. In the main document, Siberia appears in only three points:

1. Increased transport links with Heilujiang,
2. The creation of the Eurasian-Higher Transport way "Moscow - Beijing" along the route of the Trans-Siberian Railway
3. Creation of the China-Mongolia-Russia economic corridor.

The first proposal is related to the reconstruction of the existing Karymskaya-Zabaykalsk railway, the second is highly competitive with the southern route of the high-speed rail route being built through Urumqi (although there is also a study of the construction of high-speed rail from China through the territory of Mongolia to Ulan-Ude), therefore, the third point is of greatest interest, which involves the creation of the economic corridor "China - Mongolia - Russia"

Therefore the last proposal is not as transition path as such because mainly it is the way to natural resources of Mongolia and East Siberia and Irkutsk region in particular. It shows the increasing growth of raw material export to China by customs statistics. For Irkutsk region the main problem is raising felling of timber to export to China. In order to stimulate processing in the region, customs duties on the round timber were increased from July 1, 2007 from 6.5 to 20%, and from 2009 to 80%. But it wasn't enough to stopping illegal timber export.

One way or another, the creation of the China-Mongolia-Russia economic corridor, which is currently at the declaration stage without a feasibility study and implementation deadlines. But nowadays there is effective instrument for regional development for such peripheries as Irkutsk region that is Silk Road Fund. The Silk Road Fund, created as part of the Silk Road Economic Belt concept, can become an effective tool for implementing projects in the Irkutsk Region, but it is necessary to refrain from completely transferring enterprises to Chinese investors.

The implementation of the concepts of transport corridors should be linked to industrial development projects to obtain greater benefits for the Irkutsk region. One of these projects is New Angarstroy, which will turn the Irkutsk region into a major industrial center and weaken the export-raw direction of its development. It's realization can forced by partnership of the government of Irkutsk region and Silk Road Fund.

The old project of construction of the Mogzon - New Uoyan railway line can be revitalized by including to the Economic belt Silk Road project and will give impetus to the full development of the BAM zone. The integration of the Irkutsk region into the Economic belt Silk Road project with the condition that a large industrial base be created in it will help to strengthen its geopolitical position. Any concept of a "transport corridor" implemented in resource-oriented peripherals can enhance the effect of the export of raw materials abroad without receiving local rents.

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SOME ENVIRONMENTAL PROBLEMS OF WATER RESOURCES IN IRKUTSK, ULAN-UDE AND ULAN-BATOR

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Cities of Irkutsk, Ulan-Ude and Ulan-Bator with their surrounding industrial area are the largest urban centers of the Baikal region. Location of Irkutsk and Ulan-Ude urban areas and the lake Baikal determines the direct relationship of these objects, but the direction and degree of connections are different. Ulan Bator doesn't have a direct connection with the lake, but is located in the Selenga river basin and also has an indirect impact on the lake's ecosystem. There are significant differences in the water supply to the population and industry, and variety of water-ecological problems of the territories.

The water supply of Irkutsk is based on the use of surface water, provided by the Angara river, which flows from the lake Baikal. The volume and chemical composition of water in the river are determined mainly by the lake; the quality of water depends on the conditions of wastewater disposal as well. The main pollution enters into the Angara near Irkutsk with insufficiently treated urban and industrial effluents. The most common pollutants of the Angara river water are phenols, nitrites, organic compounds; the average level of pollution is "conditionally clean" and "slightly polluted". The low-water period in the Baikal region caused a reduction of the water level of the Angara river and its tributaries. The current situation has increased pollution and eutrophication of the water body, created a critical situation with water supply to the population and industrial enterprises in Irkutsk and suburban territories.

In Ulan-Ude, water supply is mainly based on the use of underground water, on the exploitation of the aquifers of modern Quaternary sediments of the Selenga and Uda river valleys. This system doesn't depend much on climate parameters, but these underground waters have a high hydraulic connection with surface water and aren't protected from pollutants. Within the city and its surroundings, pollution of exploited underground horizons is recorded, which affects the quality of water supply. There is a growth of phenols, petroleum products, fluorine and other substances coming from industrial enterprises in the ground water.

Municipal and industrial effluents of Ulan-Ude center are discharged to the Uda and Selenga rivers, whose pollutants are transferred to the lake Baikal then. The water quality in the Selenga river is "polluted" and "very polluted". The main pollutants are manganese, iron, copper, zinc, phenols and organic compounds.

The water supply of Ulan-Bator is also provided mainly by underground water of alluvial sedimentary aquifers of the Tuul river valley. There is an increase in depletion and pollution of underground horizons, which is largely associated with the transformation of groundwater supply areas as a result of economic development of these territories. A significant negative factor is the pollution of the exploited groundwater horizons as a result of the receipt of pollutants from the city's treatment facilities, industrial enterprises, as a result of filtration of runoff in suburban settlements. In Ulan-Bator, proven groundwater reserves of good quality do not provide intensive development of the city and surrounding area, and therefore, water management programs are being developed to optimize consumption and protect water resources from pollution.

The surface waters of Ulan-Bator represented by the Tuul river are characterized by good indicators above the city and low water quality in the industrial zone, below the city. There is an influx of polluted river water into the underground horizons. Thus, the water supply of urban areas is associated with a series of environmental problems, as in terms of water supply to the population and industry, and with anthropogenic impacts on natural water.

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FREE ECONOMIC ZONES OF CHINA AND THEIR ROLE IN THE DEVELOPMENT OF THE COUNTRY

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In the development of the PRC, free economic zones (FEZs), which are separate territories of the country, have preferential currency, tax, and customs regimes that are favorable for external and internal investments, have played and continue to play a significant part. In China, their influence was provided by a strong economic impetus for the development of not only the territory of presence, but the country as a whole. This is confirmed by more than thirty years of history of the existence of five special economic zones. Thanks to these territories, China at the end of the 20th century held the highest position in the ranking of countries in terms of foreign investment inflows, which later allowed the country to become the first industrial power in sphere of industrial production.

The history of the creation of Chinese FEZs can be divided into three stages. Stage I - (mid-1980) five special economic regions were created, of which four cities - Shenzhen, Zhuhai, Shantou and Xiamen - were considered completely free zones (Xu Zize, 1993). Another FEZ was Hainan Island, which is also a province. The main task of these territories was to communicate with foreign countries and attract foreign investment; Stage II (1980-1981) the creation of SEZs in Guangdong Province, as well as in the cities of Shenzhen, Zhuhai and Shantou (Guangdong Province). The most effective was the FEZ in Shenzhen, because by the end of the 80s, its GRP growth four times exceeded other economic zones; Stage III (from 1981 to 1988) during this period, zones are divided into combined forms (Shenzhen and Zhuhai) and zones with a focus on manufacturing exports (Shanpu and Xiamen) and the introduction of incentives for foreign entrepreneurs investing in old enterprises . In May 1984, 14 coastal cities, including Shanghai and Guangzhou, received the status of “open” cities. By 1988, there were already 32 such cities (Kozhevnikova, 2014). All this contributed to the attraction of foreign capital and the development of trade cooperation with foreign countries.

At the beginning of 2000, there were 180 different types of SEZs in China. Currently, the following main administrative and economic entities with preferential treatment operate in the country: 5 special economic zones; 90 zones of technical and economic development of the state level; 75 zones of new and high technologies; 13 free customs zones; 14 zones of cross-border economic cooperation at the state level.

The opening of China to the inflow of foreign investment and the formation of special economic zones stimulated the movement of a new wave of industrial activity in the coastal areas (South China). Guangdong Province took advantage of its proximity to Xiangang (Hong Kong), and the area became the main source of foreign exchange earnings. The coastal cities of the northern provinces also benefited from foreign investment and new ties to the global market.

The history of the development of SEZ in the territory of the People’s Republic of China quite clearly proves that exemption from customs duties, privileges for foreign entrepreneurs and the creation of conditions for attracting investments can positively change the economy of the state. Chinese SEZs not only allowed China to enter the list of the most developed countries in the world, but also became an example for other states that adopt their experience.

DEVELOPMENT OF BIG BUSINESS: REGIONAL SPECIFICITY

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The Baikal region (that includes the Irkutsk region, the Republic of Buryatia and the Zabaykalsky Krai), as a part of Siberia and the Far East, is located in Northeast Asia. The presented variety of natural, industrial and labor resources allows us to attribute it to the most significant regions for the development of big business. Of greatest interest are resource-mining assets and enterprises of the first redistribution, as well as systemically important companies (these are transport and energy enterprises), most of which have come under the control of federal corporations. According to the level of representation and interests of big business the Baikal region, the subjects of the Russian Federation under consideration fall into different groups (Ippolitova, 2015). Irkutsk region belongs to the group of basic regions for the development of big business, as it is a leader both in the number of corporations (there are more than 10 of them) and in their diversity. The region has favorable resource and energy prerequisites for further expansion of the scope of companies. According to the volume of investments in fixed assets per 1 person, the Irkutsk region takes a leading place among the subjects of the Baikal region. 53.9% of the region's population live on its territory and it has 63.8% of all investments. The concentration of investments (78.7% of the region's investments) in the regional and industrial centers, as well as in the areas specializing in mining operations, indicates their territorial unevenness.

Big business in the Republic of Buryatia does not differ in industry diversity and is represented by systemically important and mining companies, as well as defense industry enterprises. 22.1% of the region's population and 9.5% of all investments are concentrated in the republic. By the volume of investments in the capital asset per capita, the republic takes the last place among the subjects of the Baikal region. Investments are mainly concentrated in the regional center and regions with developed extractive industries (83.9% of all investments of the republic). There are enterprises of 6 corporations in the republic.

The Zabaykalsky Krai is included in the group of regions that are unattractive for the development of big businesses, but in recent years the situation has changed. There is an increase in investment, primarily in the mining industries, which is associated with the beginning of the active development of the mineral resource base of the region (gold mining, copper industry). The main investment flow is directed to the regional center (69.0% of all investments of the region) and areas that specialize in the extraction of mineral raw materials. 4 companies represent the interests of big business in this region.

The territories of presence of big business in the Baikal region are represented by 8 urban districts and 15 municipal districts. They concentrate 57.4% of the population of the region, 78.5% of those employed in mining and manufacturing, 83.3% of investments.

The presence of big business in the region has both positive and negative effects. On the one hand, big business initiates significant economic and social projects in the region, which has a positive effect on employment and incomes of the population, and can act as a budget-forming element of the territory (through the tax on personal income). On the other hand, "... it reduces the regional component in the increase in value added..." (Nefedkin, 2018, p. 112), which does not affect the socio-economic development of the territory in the best way.

FEATURES OF THE ECONOMIC SPECIALIZATION OF THE BAIKAL REGION

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The Baikal region located in Siberia and the Far East belongs to the large macro-region of Northeast Asia. The economy of the region is focused mainly on the extraction of raw materials and their primary processing. Two thirds of the region's industrial production are exported to other regions of Russia and the CIS countries, up to 80% of the consumed industrial products are imported from other regions. The natural conditions for the development of agriculture in the region are mostly extreme: the bioclimatic potential of the agricultural zone is 2-2.5 times lower than in the European part of Russia. Accordingly, to obtain a unit of agricultural production here, incomparably greater energy costs are required. All these factors determine the economic specialization of the Baikal region, which widely varyin the economy of the Irkutsk region and the Trans-Baikal Territory, the main share in GRP belongs to the mining industry (33.4% and 15.4%, respectively), in the Republic of Buryatia to the manufacturing industry (10.9%), agriculture is important both in Buryatia and the Irkutsk region - 4.2 and 4.6% respectively, in Transbaikalia – 2.4%.

In economic terms, the Irkutsk region is the most developed, as there is a high level of concentration of production that is directly related to the raw material base and a unique combination of fuel and energy resources, the importance of which has significantly increased in connection with the industrial development of oil and gas resources. The economic complex of Buryatia is distinguished by its industrial-agricultural orientation, as it has a significantly lower production potential compared to the Irkutsk region. Industrial production is more focused on the domestic market. The Trans-Baikal Territory stands out among the considered subjects of the region by the lowest indicators of economic activity, the increased importance of the extractive sector of the economy, and the high importance of the food industry in the structure of processing industries.

Agriculture plays a secondary role in the economy of the Irkutsk region. Its main purpose is to satisfy the needs of the local population in agricultural products. At the same time, in the Trans-Baikal Territory and the Republic of Buryatia it is one of the leading industries, which plays a key role in the livelihoods and employment of the population. Livestock breeding dominates in the Trans-Baikal Territory and the Republic of Buryatia, which accounts for more than 70%.

The leading industry of specialization, both public sector enterprises and farms in the Baikal region, is meat and dairy cattle breeding. A significant role is also played by the cultivation of cereals and vegetables to create a local food base. Some farms maintain herds of deer. The main share of livestock products (in some regions the share reaches 80–90%), as well as potatoes and vegetables in the region, are produced by the private sector, including farms and households. Commodity agricultural production is concentrated in the Baikal region mainly in the forest-steppe regions adjacent to the Trans-Siberian Railway. In the northern regions, it is of a consumer nature and is represented by focal non-market meat and dairy cattle breeding and the cultivation of vegetable crops and potatoes.

Currently, the mining sector of the economy is growing in the Baikal region, which is connected with the active development of natural resources, i.e. there is a bias towards the raw material economy. Agriculture in the region doesn't play a significant part. In the economy of the Irkutsk region, agriculture plays a secondary role; its main purpose is to meet the needs of the local population in agricultural products. At the same time, in the Trans-Baikal Territory and the Republic of Buryatia it is one of the leading industries, which plays a key role in the livelihoods and employment of the population.

LOCAL RESPONSE OF LAND SURFACE TEMPERATURE TO LAND COVER CHANGES ON THE MONGOLIAN PLATEAU

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Transitions of terrestrial ecosystems associated with land use and cover changes (LUCC) affect the climate at local to regional scales(Xian et al. 2020).However, little research has directly quantified the local response of climatic factors to LUCC. In this study, we used satellite measurements of land surface temperature (LST) over changed land covers and adjacent unchanged types on the Mongolian Plateau to understand how LST response to LUCC. The land covers are classified into forest, grassland and non-vegetated land according to leaf area index at 0.05°×0.05° spatial resolution. The percentage of different land covers within 0.05°×0.05° grids is also quantified. Positive recovery of land covers is observed in the transition zones from 2001 to 2018, i.e., transformation from grassland to forester from non-vegetated land to grassland. The grids whose major land cover types have changed (denoted as G2F or N2G) are selected to observe the LST response. On average, annual daytime LST of G2F is higher than that of forest at about 0.73±0.83℃ (mean ±Standard Deviation) and lower than that of grassland at about 0.71 ± 1.22℃; annual nighttime LST of G2F is lower than forest at 0.42 ± 0.71℃ and higher than grassland at 0.29 ± 0.66℃; annual daytime (nighttime) LST of N2G is higher than that of grassland at 1.06 ± 0.86℃ (0.73± 0.78℃) and lower than non-vegetated land at 0.98± 0.97℃ (0.65± 0.91℃). It indicates that forest cover gains on grasslands result in net cooling as the magnitude of nighttime warming is smaller than the daytime cooling and grassland cover gains on non-vegetated lands mean daytime and nighttime cooling. The underlying processes of LST responses are different for different types of LUCC. The albedo of forest is lower than that of grassland (4.95 ± 3.20%) which determines that forest absorbs more incoming solar radiation during the daytime, but reforestation indeed induces daytime cooling because increased energy loss as latent heat fluxes through enhanced evapotranspiration(1.12 ± 1.00 mm/month) exceeds the extra absorbed energy(Bright et al. 2017). Nighttime warming of reforestation is attributable to the increase of down ward long wave radiation from the atmosphere and the reduction of outgoing longwave radiation from the surface as a combined result of the increase in air humidity and the enhancement of near-surface atmospheric boundary layer originally relating to the enhanced daytime evapotranspiration (Peng et al. 2014). The average albedo of grassland is larger than non-vegetated land (0.56 ± 2.84%), thus low received solar radiation along with higher evapotranspiration (1.76 ± 0.84 mm/month) results in annual daytime cooling of grassland restoration. The same open space of grassland and non-vegetated land does not affect the energy release during the nighttime, thus grassland with low daytime heat storage forms a nighttime cooling effect. LST responses to LUCC also show seasonal variations. In winter, reforestation leads to daytime warming as the evapotranspiration is negligible. In summer, although the albedo of grassland becomes lower than non-vegetated land, daytime cooling still exists due to the increased energy expenditure of vegetation growth and evapotranspiration.

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SUSTAINABLE DEVELOPMENT IN THE NORTH-EAST ASIA: PROBLEMS OF TRANSITION TO MULTILATERAL COOPERATION

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Key features of Northeast Asia (NEA) as the space for cooperation, including the field of sustainable development (SD) are the following:

- development of trade, economic and investment relations between individual countries of the region, if there are contradictions between them in military and political spheres. This mature approach is one of the reasons for the need for multilateral cooperation in NEA in terms of SD, building "green economy", with possible contradictions in other areas;
- in spite of the efforts being made by international organizations, legislation, agreements, countries, regions, non-governmental organization (NGOs), etc., and in spite of the discussion of the problem for the second decade, NEA has not formed a region-wide system promoting sustainable development (green economy), based on the interaction of all countries in the region. In the region, two-sided (rarely at maximum tripartite) format dominates in solving SD issues, eg, People's Republic of China (PRC) - Russian Federation (RF), RF-Mongolia, PRC-Mongolia, RF-Japan etc.;
- states are the subjects of international treaties in NEA in the field of SD, while the main cooperation is implemented at the provincial level. This is most significant in China, RF, Mongolia, which are included in NEA as its regions and in which, compared with the metropolis: A) limited opportunities for representation in international cooperation, B) their own vision of priority issues for the transition to SD and boosting "green economy", C) real resource-economic and environmental relationship and interdependence with neighboring territories;
- a large part of multilateral cooperation of NEA is supported by the activities of international organizations and NGOs (subregional commission for NEA and субрегиональная комиссия для СВА и ЕА ESCAP, GTI, UNEP NOWPAP etc.).

Based on "natural capital" and the structure of environmental resource problems in the Russian Far East (RFE) there are basic prerequisites for the international format of cooperation in NES in terms of SD:

1. South of the RFE, north of the Korean peninsula and part of North-East China are a single ecoregion, with most of its biodiversity preserved on the Russian territory. Its preservation in international cooperation guarantees the possibility of its restoration in the future in NEA in general;
2. Transboundary pollution of water resources in the south of the RFE and their management: the Amur river, the Razdolnaya river, the Tumangang river;
3. Atmospheric transboundary transport (West-East) of pollutants from East Asia emission centers to the south of the RFE;
4. Transboundary pollution of the seas: Japanese sea, Sea of Okhotsk.

To move to a new level of multilateral cooperation in NEA, it is necessary:

- recognize the insufficiency of the existing bilateral approach to achieving SD goals in NEA,
- critically adapt global SD goals (17 SD goals as of 2015) to the specifics of NEA and its subregions,
- conduct division of NEA into subregions according to the specificity of SD goals,
- identify NEA subregions for which the priority is the transition to multilateral cooperation in the field of achieving SD goals.

From our point of view, such priority subregions are the Amur river and Tumangang river basins.

In conclusion, it should be noted that the increasing problematic of the current stage of globalization encourages countries to develop mechanisms for solving global problems at the level of the regional dimension and local-territorial approaches.

INNOVATIVE ENTREPRENEURSHIP AS A FACTOR OF SUSTAINABLE DEVELOPMENT IN IRKUTSK REGION

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The introduction of high technologies in the work of small and medium-sized businesses is a priority to reduce social tension and create positive socio-economic changes for sustainable development of the regions. Irkutsk region is located in a strategically important place that compares favorably both by its geographical and economic position. Irkutsk region has significant natural and mineral resources potential. Moreover, severe climate conditions and remoteness from the central regions of the country lead to an increase in the level of production and transportation costs. The regional government, the Siberian branch of the Russian Academy of Sciences and the leading universities of the Irkutsk region are collaborating in the development and creation of science-intensive and high-tech industries. The transition from a raw material strategy to the dynamic development of territorial production complexes for the development of natural oil and gas resources in the Northern territories of the Irkutsk Region contributes to the creation of new jobs and the growth of small and medium-sized businesses. According to scientists, the development of deposits is promising for the next 100 years; therefore, it is necessary to create science-intensive and high-tech industrial and service enterprises. The fuel and energy resources of the region, using innovative energy-saving technologies and high-tech equipment in the oil and gas industry, will let to increase the energy efficiency of the economy and improve the environmental situation. According to statistics, medium-sized and small enterprises of the Irkutsk region provide 27-28% of the total turnover of all enterprises in the region, but only 13% of the surveyed small enterprises operate at full production capacity. Nevertheless, entrepreneurship is developing; in 2015, there were 12 small enterprises per thousand inhabitants of the Irkutsk region, in 2019 - 16.

Many entrepreneurs close their production; the main reason for the closure is the lack of knowledge about the demand for products, promotion, limited access to funding opportunities, lack of exchange of information with partners, lack of skilled workers. Increasing labor productivity in large industrial enterprises leads to a reduction in workers. Entrepreneurs create new jobs for downsized employees of industrial enterprises who have undergone additional training or retraining. Creation of new high-tech jobs is a prerequisite for the introduction of innovative methods for sustainable development of the Irkutsk region. Technopark of Irkutsk National Research Technical University takes a leading place in the development and implementation of expert seminars, master classes and trainings, retraining or advanced training courses for industrial entrepreneurs. The Center for Social Sphere Innovation (CSSI) of Irkutsk State University (ISU) promotes and supports social projects of entrepreneurs and socially oriented non-profit organizations. The Fund “Support Center of Small and Medium-Sized Enterprises in the Irkutsk Region” provides support in order to help businesses to increase the production level, to develop a management system and to introduce new products.

Effective interaction of small and medium-sized businesses, educational and scientific institutions, the entrepreneurship support fund with the participation of state and regional governments and with the attraction of investors leads to the sustainable development of the region on the basis of six industry clusters. The creation of science-intensive and high-tech industries based on technologies for the conservation and restoration of the natural resources of the Baikal region raises the level of efficiency of small and medium-sized businesses and helps to attract investments and to ease access to international markets.

THE RESOURCE-CLIMATIC POTENTIAL OF URBANIZED TERRITORIES (A CASE STUDY OF THE CITY OF IRKUTSK)

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Because of the characteristic properties of climate formation, every so often the urbanized territories of Northeastern Asia experience chronic atmospheric pollution, which is one of the main problems of their sustainable development. On the basis of the expanded concept of natural resources, we examine the influence of the climate/atmosphere resources of Irkutsk on human livelihoods.

The living conditions of the population are determined by the location of the city on the Irkutsk-Cheremkhovo plain, and by a combination of the cooling (in summer) and warming (in winter) influence of the water masses (of the Angara, Irkut and Irkutsk reservoir) and the individual peculiarities of the location at different altitudinal levels. The climate of the city is distinguished primarily for change in the atmospheric air quality and spatial variation in air temperature.

Winter—a period with a daily mean air temperature below –5°C – lasts from early November till late March. The coldest moth is January; according to long-term data, its mean temperature is –20.6°C. The mean winter air temperature in the center of the city is higher than outside the city by 3-4°C, and the number of days with a daily mean temperature below –15°C now exceeds twice its values in the neighboring topographically low areas (40 and 80 days, respectively). Summer – a period with a mean daily air temperature above 10 °C – is usually dry with a large number of clear and warm days in its first half (June–early July) and most often rainy in its latter half (from mid-July till late August). The mean July temperature (17.6°C) in the city is less than 1°C higher than outside the city. The contrasts of air temperature in different parts of the city during the clear daytime can reach 5°C in January and up to 3°C in July.

The characteristic features of the climate of Irkutsk, as with the entire north-east of Eurasia, are the specificities of the atmospheric circulation. The powerful long-lasting seasonal and diurnal inversions are responsible for a deceleration of the processes of mixing and dissipation of pollutants emitted into the atmosphere. A combination of the average conditions for dissipation of pollutants with significant amounts of emissions is the main cause of a very high air pollution index (API) over a long (longer than 20 years) period. An exceedance of hygienic standards is observed annually for 5-6 pollutants, on average. Furthermore, the composition and concentration of priority pollutants vary but the concentration of suspended solids remains stably high (up to 2.4 MPC). A cause of particular concern is an increase in exceedance of MPC for benzo(a)pyrene (up to 7.8 MPC), which is due primarily to the low quality of fuel used by mobile and stationary sources of emissions and to an increase of the number of automobiles.

The average parameters of atmospheric quality considered in this study are due to the orographic characteristics of the city which promote formation of local zone of atmospheric pollution of a different intensity. Analysis of the present-day chronically low atmospheric quality in Irkutsk dictates a need to seek possible ways to improve it, having regard to the climatic potential of the city.

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PATTERNS OF DEVELOPMENT AND DISTRIBUTION OF SOIL COVER IN THE TERRITORY OF THE SOUTHERN PREDBAIKALIA

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The territory of the Southern Predbaikalia occupies the southeastern part of the Central Siberian Plateau of the southern margin of the Siberian Precambrian Platform (52-54 ° N, 102-105 ° E). It includes the Irkutsk-Cheremkhov Plain and the southern part of the Pre-Baikal Depression, which are the marginal troughs of the Siberian Platform, as well as the Priolkhon Plateau, a tectonic block sandwiched between the Baikal Range and the Baikal Depression. Subtaiga, forest-steppe, steppe and dry-steppe landscapes are widespread in the region, which are currently under active development. The Southern Predbaikalia differs from many other regions in the great diversity of its climatic conditions. The combined effect of the hollow effect and the arid-shadow form of vertical zonality in the territory of the Southern Predbaikalia led to the presence of sharply contrasting landscapes from a subtaiga to dry steppe on a limited area. The most important factors of soil formation, climate and topography, determined the uniqueness of the mechanisms of local circulation of air, heat and moisture, affecting the diversity of soils, their distribution at the macro- and mesoscale. The diversity of subtaiga soils is represented by sod-podzolic soils, podzolized burozems and residual-carbonate burozems, typical steppe gray and gray metamorphic soils, clay-illuvial chernozems, steppe and dry steppes, disperse-carbonate and chestnut brown soils, and differentiated chestnut soils. structurally-metamorphic, humus-accumulative and accumulative-carbonate sections and the post-litogenic trunk. The complex geological structure, the different age and variety of bedrock, the composition and degree of weathering of soil-forming species caused the differentiation of the soil cover of the territory, the distinctive nature of soil formation, and contributed to the formation of peculiar soils, in particular residual carbonate burozems. The paleogeographic situation in the form of a bumpy-lowland paleocriorelief determined the differentiation of soil formation processes at the micro level of soil cover organization, which caused its significant complication and diversity in the form of contrasting soil microcombinations represented by complexes of automorphic, autonomous soils at hillocks and semi-hydromorphic cryogenic formations (hollows). It has been established that soils formed under these conditions sharply differ in genesis, type of soil formation, morphology, and properties. The main “zonal” soil types of the corresponding landscapes are developed at the hillocks. Their profile is formed in the undisturbed mass of soil, which corresponds to the post-litogenic type of soil formation, and periodic drift of soil material indicates a denudation model of pedogenesis. In depressions, soil formation occurs in the redeposited soil material of cryogenic wedge-shaped structures. The presence in their profile of one or more buried humus horizons corresponds to the synlitogenic type of soil formation and the accumulative-sedimentary (sedimentation) model of pedogenesis. As a result of the work, a map of the soil cover of the Southern Predbaikalia was compiled using the Quantum-GIS program by interpolating the soil sampling points using landscape indication methods. It has been established that at the macro- and mesoscale levels of soil cover organization, the distribution of soils among the macrorelief elements, as well as the exposure of the slopes, play a decisive role. The soil cover under the conditions of a bumpy-lowland paleocryogenic microrelief is represented by complexes and spots, which significantly affects its complication, which increases during development.

LARGE PROJECTS AND SMALL COMMUNITIES: THE INFLUENCE OF INDUSTRIAL DEVELOPMENTON REMOTE VILLAGES IN EASTERN SIBERIA

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The active development of the oil and gas extractive activity, as well as the logging industry in the East Siberian region, involves more and more remote areas, where small Indigenous peoples live and continue to engage in traditional nature resource use: hunting, reindeer herding, fishing, and gathering. Industrial activities may significantly transform the familiar environment; natural landscapes as well as social connections are changed (Yakovleva, 2011). In this regard, the theme of sustainable development of this territories have particular relevance: can the traditional land and livelihood activities of Indigenous peoples be preserved in the new conditions; how will the socio-economic environment as a whole react, will there be new points of economic growth in these remote territories.

This paper will consider one of the aspects of the sustainability of socio-ecological systems - the ability to adapt to changing conditions (Walker et al., 2004; Berman et al., 2004; Petrov et al., 2016). The study is conducted on the example of south settlements of Katangskii district - the northernmost district of the Irkutsk region, where the logging and oil and gas extractive industries are actively developing. Katangskii district is the most inaccessible territory of the Irkutsk region. There are no all-year-round roads, regular communication is provided only by air. Nevertheless, most part of the district is influenced by several large infrastructural projects. In recent years the most significant from them the East Siberia - Pacific Ocean (ESPO) oil pipeline and the Vilui highway have become. Analysis of the adaptation of local residents to new conditions is based on field research materials, which included semi-structured interviews with local residents and participant observation, official socio-economic statistics, and reports of local authorities.

Albeit, the ESPO route passes through the neighboring districts Ust-Kutskii and Kirenskii, the influence of the pipeline for the Katangskii district is enormous. In the mid-2000s, this project led to the growth of geological exploration in the region in order to increase hydrocarbon reserves and to fill the pipeline. As a result, the number of hydrocarbon fields in the Irkutsk region increased from 11 in 2006 to 42 at the beginning of 2018. Nowadays there are about 15 fields already in operation, and 5 of them are located in the southern part of the Katangskii district (Gosudarstvenyi…, 2019). The operating oil fields are connected to the ESPO pipeline network and are serviced all-year-round not only by air but also by land on special technological roads.

The final version of the federal all-year-round road Vilui A331 was accepted in 2009. According to the last version, part of the route will pass through several settlements of the Katangskii district along the Mirninskaia winter road connecting the Irkutsk region (Ust-Kut) and the Republic of Sakha (Yakutia) (Mirny). However, in Irkutsk region, the road has an all-year-round status only to the village Verhnemarkovo of Ust-Kutskii district. Although industrial companies already partially use the Mirninskaia road as all-year-round in Katangskii district too.

These infrastructural projects impact on the locals' life in different ways. A significant part of the territory of traditional activity is affected by industrial work. Local hunters noted in interviews that the productivity of hunting grounds decreases in areas of high industrial activity. Technological roads unofficially change the village's connectivity with other settlements. These roads are absent on the public map, but they have great importance for local mobility. The growth in the flow of people and goods on the roads, primarily on the Vilui highway and its winter part – the Mirninskaia road, contributed to the development of local small businesses in the service sector: seasonal cafes, shops, mini-hotels. The analysis of the local's adaptability to changing conditions will be done on these examples.

The research was conducted in collaboration with scientific projects: "Informal Roads: The Impact of Unofficial Transportation Routes on Remote Arctic Communities" supported by NFS (#1748092), "Innovative development, territorial organization, and quality of life improvements for the population of the Siberian and Arctic regions of Russia" funded by RFBR #16-02-00570(a), and the research project 'Configurations of "remoteness" (CoRe)–Entanglements of Humans and Transportation Infrastructure in the Baikal-Amur Mainline (BAM) Region' (FWF) [P 27625].

JUSTIFICATION OF THE NEED FOR FORMING A FRAME OF MUTUALLY COMPLEMENTARY INDUSTRIAL INNOVATION CENTERS IN THE ULTRACONTINENTAL CORE OF THE EURO-ASIAN SPACE

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The chain of interrelated or mutually influencing events taking place in the modern world economy, social sphere, geopolitics, information and communication sector, adjusted by the pandemic, is leading to unexpectedly rapid changes in almost all components of global human development. The presence of super-powerful computers and explosively growing technologies did not lead to the same results, and today's epidemic has acted as an additional detonator, which practically blew up the wall of hypocrisy and omissions in front of ordinary consumers of information. The geoeconomic and socio-political problems of world development in the context of a sharp decline in incomes and the quality of life of the population, which have long been known to leading experts not affiliated with any political interest groups, have become obvious to ordinary residents of different countries and territories.

It turned out unexpectedly that the population can live, significantly saving on a variety of services and goods, and modern technologies aimed at improving the quality of life of the population and a seemingly fairer social world contribute to an even greater stratification of society and the introduction of those innovations that have turned out to be very little predictable. In these conditions, living conditions for the population of territories located in the most vulnerable places of the planet are sharply deteriorating. These, along with extremely cold or hot places, include the cores of ultra-continental territories. These territories naturally include the territories of Central Eurasia located in the countries of the former socialist camp (USSR, China, Mongolia).

Among the main features of the spaces under consideration, in addition to the remoteness from the open seas, one should mention the relatively low population density, the discharged network of cities, the absence of highly marginal natural resources of the energy sector, the depression of industrial development, the absence of a cementing and guiding principle or center of territories, as well as any effective joint strategies of socio-economic development, weakness of research and innovation centers, low initiative and atomicity of local communities, development, as a rule, of separate value chains without the upper most profitable stages. It is on the last of the named components of the development of these territories that attention should be focused on when developing a strategy for the spatial and formation development of centrally located Euro-Asian territories. One of the possible ways of development could be the creation of a network model of a frame type on the basis of existing large cities of completely new industrial and innovative centers that hold together the entire space and direct their population and economy to the development of certain most competitive and demanded sectors of the economy that can ensure the best production efficiency of products cycle. And here we can see some analogies with the planned system of the Soviet Union, significantly modified through institutional, technological and anthropocentric innovations.

Along with the already recognized leaders of a subnational scale (Novosibirsk, Urumchi, Almaty), the agglomerations of Barnaul, Irkutsk, the Tashkent-Shimkent hub and the Rubtsovsko-Semey cross-border industrial hub can be considered as cores or nodes of the future intensive advanced development of the space under consideration, as well as, possibly, – in Jiuquan City District, Gansu Province. Each of the named cores of macroregional development has its own polymodal specialization. With a joint, detailed development strategy, the considered ultra-continental Eurasian space has an opportunity for a full-fledged, and not as a raw material appendage, breakthrough economic development while preserving the environment, creating a modern infrastructure and improving the quality of life of the local population.

SUSTAINABLE DEVELOPMENT OF RECREATIONAL AREAS IN NIZHNEVARTOVSK

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The territory of the city of Nizhnevartovsk is located in hypocomfort climatic conditions for human life, the nature is very changed as a result of anthropogenic influence, technogenic landscapes dominate, so there is a need to analyze the recreational potential of the territory for competent planning, design of recreational zones and conservation of natural recreational resources.

The article analyzes the recreational resources of the city of Nizhnevartovsk, taking into account the recreational activities of the local population, and examines passive recreation from the point of view of recreation at the place of their main residence. Considering recreation as any activity that takes place in free time, and aimed at the emotional and physical satisfaction of human needs for rest, relaxation and recuperation, the analysis is subject to walking, visiting cultural and leisure centers, as well as visiting public areas and social and business centers.

The paper considers an urban area located in fairly harsh climatic conditions, so a special role is played by a group of socio-economic recreational resources. These include historical and cultural objects (monuments and memorials, museums, etc.), cultural and leisure and sports centers, as well as any man-made objects suitable for recreation (parks, embankments, etc.).

An important component of the urban landscape are parks – the main recreational areas of the city. Recreation in parks is a highly valued ecosystem service of green infrastructure. Urban parks are experiencing a high anthropogenic load.

Nizhnevartovsk has one city Park located between 60 let Oktyabrya and Pionerskaya streets-parallel to the Ob river embankment. Popular recreation area of the city's population – Komsomolsky Boulevard. The embankment along the Ob river is also a unique element in the architectural layout of the city. Its original decoration was the descents directly to the water. Komsomolskoye lake is one of the most important recreational areas of Nizhnevartovsk, especially for residents of adjacent neighborhoods that are remote from the city center. The newest recreation area in Nizhnevartovsk is Neftyanikov square, located on Pobedy Avenue in front of the "Palace of arts".

Since Nizhnevartovsk is a Northern city with harsh climatic conditions, cultural and leisure and sports centers, especially indoor ones, are of great importance for the recreation of citizens. There are libraries, municipal institutions of additional education for children, and municipal institutions of club type. In recent times the value of the recreational centers are shopping centers that are currently and in the recreation centers.

Currently, the most important task of sustainable development of human settlements is the analysis of territorial recreational zones and recreation facilities in the conditions of dynamically developing urban development.

PROBLEMS AND PERSPECTIVES OF THE DEVELOPMENT OF INEFFECTIVE GOLD MINES

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A significant amount of gold mining in Russia and the Trans-Baikal territory falls on easily digestible mineral resources, such as placer deposits. The Trans-Baikal territory has a huge potential for gold reserves located in inefficient placers that are not of industrial interest to large subsoil users, since they have a low mineral content and quality. These include deposits with off-balance reserves, as well as objects with forecast resources, such as all small streams located in the decays of the main river bed, and many technogenic objects, which include various types of dumps, pillars, sections of the raft containing gold in pockets and depressions, tailings of concentrating plants and plants, deluvization sites on the slopes of terraces, modern alluvial loops, and scythe placers are among them. In the regions of Russia, there are more than 10,000 such placers, including intheterritoryoftheregiontheirquantityisestimatedandapproximately 600 (about 217.269 tons of gold are concentrated in them), which is not a final figure upwards. The analysis is complicated by the lack of a cadaster with which all such placer objects could be taken into account.

The current trend in gold mining indicates a gradual reduction in cost-effective (from the point of view of the cost-benefit criterion) gold reserves due to the nature-forming factor, since it is the key factor affecting the profitability of mining. Reducing balance sheet reserves and the existing pace of placer gold mining give enterprises 5-10 year supply reserves

The complexity of developing these objects lies in the fact that most of them are not taken into account, it is difficult to calculate the exact amount of gold reserves in them. The development of such deposits by traditional technologies due to insignificant metal reserves is not economically feasible. Their development requires the same amount of permits and funds as for the development of large or medium-sized placer deposits. Therefore, existing gold mining enterprises do not deal with them. Nevertheless, the current situation is such that today these objects are mastered in a “barbaric” way, the so-called “black” miners, that is, subsoil users who do not have the right to conduct such activities. Also, licenses for many of these objects are acquired by various companies for geological exploration, but in fact they conduct gold mining. These groups of subsoil users in view of the prevailing “favorable” circumstances for them are harmful to the environment, since they do not comply with the necessary measures of environmental legislation

The bulk of in effective gold placers is located in area of the Trans-Baikal territory, which were previously large mining, today they are to some extent “dying or withering” settlements. Establishing a moratorium on the development of deposits on rivers pf important people for economic activity, increasing the role of the local population, local authorities in making mining decisions, as well as increasing the effectiveness of state regulatory bodies and tougher penalties for gold miners violating environmental laws, competent exploitation of ineffective placers will contribute to improving national economic efficiency, sustainable socio-economic development of territories, and the establishment of an environmental, legal and economically sound order.

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TO THE ISSUE OF REINDUSTRIALIZATION OF THE BORDER REGIONS OF THE EAST OF RUSSIA

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The experience of Russian regions in North-East Asia over past two decades has showed rather clearly, that focusing on mining and export of substantial volumes of mineral resources, though giving definite benefits and local employment, does not provide for sufficient rates of economic growth and public wealth. The gap between eastern regions and average Russian development rates does not close down. On the other hand, these regions have considerable mineral reserves, historically shaped specialization in natural resources and in most cases surviving production infrastructure. For these reasons, an issue of re-industrialisation of the Russian East economy using modern technologies is being discussed now.

Modern technological trends and a rapidly changing pattern of resources demand at the world market must also be considered. Global environmental problems brought about the issue of wide application and development of renewable sources of power (RESOP), including development of solar energy. Explosion of investment to production of solar panels caused a sharp increase in lithium demand. During the time period from 2014 to 2018, demand on the main lithium-containing mineral (lithium carbonate) has increased by 1.5 times from 31 kt to 52 kt, which resulted in a sharp growth in lithium carbonate prices from 9 to 14 US $k per tone.

There are two types of commercial lithium deposits: hydromineral lithium-bearing brine and rare-metal granitic pegmatites – spodumene. The major proven lithium reserves are in lithium-bearing brine of salt lakes where it is represented by different compounds – about 65% (150 kt) of all lithium reserves in the world (in Chile, USA, Argentina and China). Rare-metal granitic pegmatites amount about 35% of total global lithium reserves. Content of lithium oxide (Li_2O) in deposits of this type varies from 1.3 to 3 %. Ore lithium deposits are represented by spodumene, petalitite, lepidolite, amblygonite and eucryptite; these deposits are located in the USA, Australia, Brazil, Canada, Namibia, Portugal, Russia and Zimbabwe. At present, Russia imports lithium, though it possesses considerable reserves – near 900 Mt of lithium carbonate occurring in major pegmatite deposits. The Russian State Register of Reserves includes 15 deposits with on-balance reserves and 2 deposits with off-balance reserves of lithium. Besides, during the USSR period, commercial lithium mining was performed in Siberian regions.

Rehabilitation of these enterprises must be one of the main directions of re-industrialisation of the Russian East. One of the promising facilities is Zavitinskoye pegmatite deposit in Zabaykalsky Krai, which contains of lithium oxide and had been developed till 1997. The work was suspended when cheaper raw materials appeared at the market from hydromineral deposits of the South America. However, due to increased demand and interest in spodumene deposits as a result of RESOP development, new and effective technologies of such deposits mining appear. Besides, rehabilitation of production at Zavitinskoye deposit would be central to development of mono-industry town Pervomaysk, where steady economic degradation has been taking place starting from 1997, and now employed people is 25% of working-age population. Expansion of the Advanced Special Economic Zones in Zabaykalsky Krai after its accession into the Far Eastern Federal District resulted in additional economic benefits for re-industrialisation. However, the growing demand is the basic condition for entering the market, and the time is also a success factor, which is very important not to miss.

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UNIVERSITY AS A DRIVER OF REGIONAL TERRITORY DEVELOPMENT IN THE CONTEXT OF NATIONAL PROJECTS IMPLEMENTATION

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According to HSE academic experts, higher education institutions in Russian regions are most active in helping the economy grow, developing human capital (skills, people's competence), and innovation. The largest contribution to the development of the Federal subject is made by educational centers-Moscow and the region, Saint Petersburg and the region, Tatarstan, Krasnoyarsk territory, Kalmykia, Chechnya, and the Republic of Sakha.

The contribution of universities to economic development implies tax deductions of universities to the regional budget, income from visiting students, the ratio of the average salary of University employees to the average salary in the region. Contribution to the development of human capital: training qualified employees for the labor market with their high tax income for the region, high level of consumption; contribution to innovative development: production of new knowledge, technologies, commercialization of developments (number of licenses, patents, etc.), the number of citations of publications in the RSCI and Scopus databases.

Assessing the impact of higher education institutions in three areas (sub-indices) allowed us to typify regional higher education systems: "drivers of regional development"; higher education systems with a high level of influence; systems with a moderate level of influence; systems with a low level of influence. Ranking indicators does not mean the level of development of regional higher education systems, but the degree of their contribution to the local economy of the region.

There are nine regional development drivers: two capitals with regions, Krasnoyarsk territory, Tatarstan, Kalmykia, Chechnya, and Sakha (Yakutia) (a high indicator in the "human capital development" sub-index). Higher education systems with a high level of influence include 18 regions. Eleven of them have higher sub-indices "economic development" and "human capital development" (Astrakhan, Kirov, Novosibirsk, Orenburg, Sverdlovsk regions, Zabaykalsky and Khabarovsk territories). In diversified economies, people with a high level of education are in demand. High values of some sub-indices may also be typical for regions with a large share of the public sector in the structure of the economy.

The group with a moderate level of influence of universities is the largest, consisting of 36 regions (for example, the Altai territory, Arkhangelsk, Voronezh, Kursk, Rostov, Saratov, Tyumen regions, Kamchatka territory, etc.). In the group with a low level of influence of universities, there are 15 regions (Vladimir, Amur, Bryansk, Kaluga, Novgorod, Oryol regions, Buryatia, Adygea, etc.).

Regions with large University centers where national research universities, Federal universities, and universities included in the 5-100 Project are concentrated make the maximum contribution to the economic development of territories. The income of such universities is relatively high, and this increases the investment in the local economy.

By contribution to innovation, the main innovators are Moscow, the Moscow region, the Irkutsk and Tomsk regions, and the Stavropol territory. In these regions of the Russian Federation there are active developers of know-how, generators of new technologies – major national research universities. It`s should be noted that there is no direct link between the sub-indices and the level of development of the region. Currently, universities play an important role in the development of regions, especially in the implementation of national projects.

SPATIAL-DEMOGRAPHIC INEQUALITIES AS A DETERMINANT OF SUSTAINABLE DEVELOPMENT IN SERBIA

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In an age of intensive continuous growth of world population, which imposes increased human pressure on the environment and increased need for natural resources, developing the concept of sustainable development imposes itself as a necessity. The basic feature of a population that has a direct impact on the concept of sustainable development is population dynamics, characterized by, both globally and locally, spatial inequality. In the background of this phenomenon are the basic demographic phenomena and processes - fertility, mortality, migration, depopulation, aging, etc. Opposite to places with demographic concentration and implosion are demographic eroded places. Research on the relationship between the population and the resources at its disposal at a given moment is necessary to determine adequate measures for the implementation of sustainable development.

The primary focus of numerous literature that deals with the study of sustainable development, is the population (Aquirre, 2002; Vimard P., Fassassi R, 2012; Babović, Lović Obradović, 2018), but also the determinants that directly and indirectly affect sustainable development. Fertility (Marsiglio, 2011), education (Alam, 2009), aging (Kudo, Mutisya, Nagao, 2015), are among the most important determinants. Research findings suggest that population increase and its level of concentration imply increased demands to meet human needs, which can further imply environmental threats.

This paper adopted the method of spatial autocorrelation, incorporates location information in demographic research to gain a better understanding of the demographic characteristics and potentials of Serbia's settlement system in the function of sustainable development. Following demographic determinants, based on the data from the last official census from 2011, were selected: population change index 2011/1983, population density, percentage share of over 65-year-oldsand fertility rates. The results of the research indicated distinctly spatial-demographic disparities – concentration of population in Belgrade metropolitan area with Novi Sad, then in urban centers located on naturally predisposed corridors, and on the other hand population deconcentration in rural and peripheral border areas. At the end of the paper, the authors question whether decrease of population and level of concentration unambiguously facilitates sustainable development, and what is the lower demographic threshold when the population meets all its needs without disrupting the natural system and the environment?

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THE EFFECTS OF MODERN TEMPERATURE FLUCTUATIONS ON BUILDING HEATING MODES IN THE REPUBLIC OF SAKHA (YAKUTIA)

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Recent temperature fluctuations cause a lot of debate about climate change and its possible socio-economic impact. Almost the entire territory of the Republic of Sakha (Yakutia), except for its northern limit, lies in the most severe climatic region in Russia, with an absolute temperature minimum of -68 ° C. During the coldest five day periods, the air temperature in some areas drops to -60 ° C. Access to reliable heat supply systems is vital for the human population in these conditions.

Fluctuations in the duration of the heating period (HP) and heat demand must be taken into consideration along with engineering, technical, and economic issues. This paper presents an analysis of the dynamics of main heating period parameters: duration, average outside temperature, and estimated fuel consumption index for the heating seasons from 1991-1992 to 2017-2018, based on meteorological data with daily and monthly resolution. In addition, long-term changes were analyzed using reference data (pre-1960 observations). The analysis is based on the data from three weather stations located in the Southern (Lensk), Central (Yakutsk) and Northern (Verkhoyansk) parts of the Republic Sakha.

For the period 1991 to 2018, a decrease of 4-5 days in the duration of the heating period was found in comparison to long-term data (pre-1960), along with an increase in the mean temperature for the heating period: +0.6°C in Verkhoyansk, +1.3°C in Lensk, and +2.4°C in Yakutsk.

During the time frame from 1991-1992 to 2017-2018, the duration of the heating period ranged from 244 to 303 days in Verkhoyansk, 225 to 267 days in Yakutsk, and 224 to 272 days in Lensk. The amplitudes of average temperatures for the heating period varied by 9.3°C in Verkhoyansk, 5.0°C in Yakutsk, and 5.5°C in Lensk. A more detailed analysis revealed abnormally low (>1 standard deviation) mean HP temperatures recorded 3 times in Verkhoyansk, 4 times in Yakutsk, and 6 times in Lensk; abnormally high – 4 times at each station.

The combined effect of the shorter heating period and higher temperatures results in a decrease in the calculated fuel consumption index by 3-8% in the recent decades in comparison with the pre-1960 period. Based on the 1991 to 2018 data, the fuel consumption index varied +7/-11% from the multi-year average in Verkhoyansk, +9/-9% in Yakutsk, and +11/-9% in Lensk.

Our results indicate that the recent climate change has caused an increased variation in mean temperatures and heat demand during the heating period and associated risks to urban infrastructure.

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ECONOMIC STRUCTURE OF THE SERBIAN POPULATION AS AN OBSTACLE TO SUSTAINABLE DEVELOPMENT

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In the literature, experts point out that the term sustainable development is often mistaken for similar terms and that there is no single framework for managing it (Lele, 1991). According to Daly (1990) countries that have high rates of per-capita resource usage frequently have low rates of demographic growth and their aim is more consumption control than population control and vice versa. Issues raised decades ago are still current – how to manage environmental degradation in poverty affected areas or the confusing role of economic growth on today's margins of environmental sustainability. At the 2012 Rio Summit, it was suggested that the world adopt a set of Sustainable Development Goals. These goals should include economic development, environmental sustainability and social inclusion (Sachs, 2012).

The economy in Serbia has been developed in the capital city and several other smaller towns, mostly along the Pomoravlje area (Babović et al., 2016b). Such centralized economic development is an obstacle to sustainable development. Administratively, there are 25 areas in Serbia, and in most of them a percentage of the active population that performs occupation is 30–35. The highest percentage is in the Kolubarska area (42%) and the lowest is in the Toplička area (24%). The percentage of the economically inactive population is around 60 in most areas. The highest value is in the Toplička area (65%) and the best situation is in the Kolubarska area (52%). A small number of residents do occupations and almost two-thirds of the population are dependents, in all areas. On the other hand, The Government of the Republic of Serbia adopted, in 2008, National Sustainable Development Strategy with a goal to "lead to balance three key factors…, linking them to a whole supported by institutional framework" (Vasić, 2004:6). Can one speak of sustainable development, especially the well-being of the population, if in many areas the economic predispositions are very low? The differences between development and living conditions are even greater if we descend from the area level to the municipal level. Economic underdevelopment and depopulation of settlements are certainly a major brake on sustainable development (Babović et al., 2016a).Some experts, such as Filipović (2012) and Jednak and Kragulj (2015) proposed a knowledge-based economy as a way of sustainable development in Serbia. We should work on a larger raise environmental awareness among citizens and involve them more in decision-making at the local level. Shutting down the economy in small towns and leaving the population is in favour of the environment, but this again is not a sustainable solution. The well-being of the population is a component that needs to be institutionalized at the local government level and should involve all stakeholders. As a country actively working to join the European Union, Serbia must more actively pursue a sustainable development policy at all administrative levels.

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ISSUES OF PROTECTION OF THE LAKE BAIKAL LEGAL REGIME

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Unique status of Lake Baikal has always been set to a great extent in a declarative way, but the conceptual provisions of the Federal law "On protection of Lake Baikal" have never been disputed: legal regime primarily of the central ecological zone is supported by regulatory acts; the state ecological expertise is in place, ecological control is maintained by RosPrirodnadzor, by prosecutor's office, etc.

Current initiatives, opened by authorities and their certain representatives, on amendments to the Baikal legislature define a problem of termination of the unique legal status in principle. This relates firstly to the Law's amendments' section concerning so called "special zones", which legitimize creation of exclaves inside the Baikal nature territory, including the World heritage site "Lake Baikal", with abolition of legal regimes of all statuses on the territory, for example, the Lake Baikal water protection zone, the central ecological zone, etc. The following issues have a crucial significance: persistent attempts to change the boundaries of the central ecological zone with exclusion of all residential areas; actual disregard of UNESCO World heritage committee decisions on Lake Baikal as the World heritage site.

Current ecological crisis of ecosystem, actual failure of the approved target federal projects, ecological catastrophe threats due to possible technological consequences of delay in the Baikal paper plant waste liquidation – all these do not leave any choice to scientists. Thus, the scientific council of Siberian branch of the Russian Academy of Sciences has developed and harmonized with the regions and professional community a concept and a draft document on impact regulation that enables to preserve the unique ecosystem and to keep the civil rights of local population. After international and Russian expertise the document was submitted to the Russian Ministry of natural resources and was fully included into waste water regulation section of a draft normative act.

For the purpose of scientific support to the Lake Baikal preservation, it is necessary to ensure legal ground for scientific coordination of any projects on legal corrections and program activities, as well preliminary open discussion on admission of legislature and other initiatives, which are planned for implementation on the Baikal territory. In the sphere of scientific support of measures on the Lake Baikal preservation the following points are suggested:

1. Scientific research is to be included into national and federal projects as a mandatory stage of formation and implementation of state regulation measures.

2. Normative setting of requirements of mandatory scientific expertise for any project that can impact the Lake Baikal preservation. Given functions are to be performed by Siberian branch of the Russian Academy of Sciences as the organization that conducts scientific support to implementation of the Lake Baikal reservation.

3. Institute of "expertise of the Russian Academy of Sciences" is to be used for expert assessment of any project in the sphere of the Lake Baikal protection.

THE HISTORICAL GEOGRAPHY OF SELF-SUFFICIENCY OF RUSSIAN AND INDIGENOUS HOUSEHOLDS IN THE BAIKAL REGION (XIX– EARLY XXCENTURIES)

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Food production determines the nature of land use. To identify patterns of self-sufficiency, cultural ecology approaches are applied. Life support theory is focused on identifying the flows of matter and energy between the bioregion and human communities. During the transition to hybrid models of the traditional economy, food crises arise that can continue after the stabilization of the social situation (McIntyre & All, 2000).The literature describes the specifics and features of self-sufficiency of local communities, including indigenous peoples. Most authors focus on cultural features and environmental traditions. Moreover, the "starting point" for the transformation of traditional economies is often considered their contact with industrial society. Indeed, the transformation of the traditional economy of indigenous peoples and Russian old-timers has changed the way of life, development of the territory, sources and quality of food. At the same time, these processes have a long history. The "livelihood" concept, in the "classical" cultural-ecological version, is oriented towards traditional societies (Haider, 1972); therefore, we use it to analyze the historical and geographical aspects of food self-sufficiency of households in the Baikal region.

The Baikal region combines the cultures of hunters and gatherers and agricultural production for more than 300 years. The historical geography of consumption and livelihoods is associated with Russian colonization and spatial features of the cultural contact of Russian and indigenous peoples. The Russians formed two agricultural centers: along the valleys of the Lena flowing in south taiga landscape, and in the Balagansk forest-steppe. Initially agricultural development had a fragmentary character. The Evenki inhabited landscapes of the taiga within the Lower-Tunguska, Upper-Lena and Middle-Angara basins. Should there arise any clashes with the Russians, the Evenki living in the Lena region used to forsake their native places heading northward. In the peripheral regions of settling, the Evenki maintained a closer interaction with the Russian peasant population. Toward the end of the 19th – beginning of the 20th century, most of them merged together with the Russians and Buryats thus forming culturally and anthropologically mixed populations.

We have used the data of economy statistic of household budget of the late XIX-early XX centuries (Materialy…1897,Larionov, 1970, Kokoulina, 1923). Reach massive of data represented in the reports of governing bodies called inorodnye upravy (Ragulina, 2000). The unevenness of the data series allowed us to reconstruct the food security strategies of certain groups of Russian settlers, Evenks and Buryats with varying degrees of detail.

We believe that the study of specific patterns of food consumption and production allows us to understand the depth and significance of cultural contacts between Evenks, Russian and Buryat communities in the region. The dynamics of consumption stereotype related to the availability of territorial resources, political and economic factors. Theoretical approaches to the historical study of food security of the traditional communities of the Baikal region should take into account the political, economic, cultural and environmental contexts of the development of the Siberian society.

INDUSTRIAL PRODUCTION OF REINDUSTRIALIZATION OF EASTERN SIBERIA

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Eastern Siberia (ES) is a region with a rich natural resource base, which allowed its constituent entities to have a fairly diversified industry, which has strengthened its potential in the mining, energy, building materials, food and some mechanical engineering sub-sectors.

The Industrial Production Potential (IPP) of reindustrialization reflects the existing basis for the development of new industries. It is calculated in the form of a subindex (SI), where five PP indicators are first calculated based on data and index indicators of Russian Federal Service of State Statistics according to the methodology of Ural geographers and economists (Novikova, 2017). Then, the obtained values were calculated using the linear scaling method due to the large variation in the values. SI itself is formed as the arithmetic mean of the normalized values of all indicators of the subindex.

Based on the assessment of this element of potential, 3 groups were identified: I - high (above 0.7000), II - medium (from 0.5000 - 0.6999) - Irkutsk region, III - low (less than 0.4999) - Republics of Khakassia, Tuva, Buryatia and the Trans-Baikal Territory. For the study period (2010 - 2016), Krasnoyarsk Territory (0.7545) is the leader in all components of the indicator, and the Trans-Baikal Territory (0.3326) is the outsider among the subjects of ES.

In general, the subjects of Eastern Siberia show a positive dynamics in this potential, but the ratio of values between them remains the same, as leaders "go" ahead. It should be noted that in the Irkutsk region and Khakassia, a significant part of the processing industry is represented by the production of primary processing products with a limited innovative effect - aluminum, cellulose, polyvinyl chloride, etc., although the volume machine industry is also substantial. So in 2016, 2 subjects of the Armed Forces had a share of high-tech sectors in the economy of more than 50% (Krasnoyarsk Territory - 62.4% and the Republic of Buryatia - 56%), due to the dominance in the processing of mechanical engineering. The Republic of Khakassia - 48.4% and the Irkutsk region – 48.1% behind them. The Trans-Baikal Territory and Tuva have a stable mining specialization.

Thus, a high level of IPP is noted in the Krasnoyarsk Territory and the Irkutsk Region. The smallest values belong to the peripheral zones of the economic space of Eastern Siberia. Reindustrialization is mainly associated with the process of developing new sources of natural resources, rather than the creation of high-tech industries. There is sufficient potential for local market capacity in manufacturing industries (food, light, chemical, pharmaceutical, mechanical engineering, electronics, etc.).

THE EFFECTOFRESOURCEMANAGEMENTSYSTEMIMBALANCEON SOCIAL-ECONOMIC REGIONAL DEVELOPMENT

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The focus of the strategic programmes on significance of mineral resource security, which is a constituent of national security, is conditioned by the qualitative and quantitative deterioration of resource base in terms of some fossil fuels including oil. As a result, the foundations of sustainable development of national economy are destructed, since «resource adequacy» determines the economic capacity in deficit-free energy resource provision of the national economy (Pshenichnikova, 2017), and, hence, social-economic development of the regions in Russia. The choice of the RF oil-producing regions for research (the Komi Republic, Tatarstan, the Udmurt Republic, Samara and Tomsk Oblast) has been made based on the similarity of the regions in terms of several parameters, namely, prevalence of small and medium oil fields in the resource base, contribution of oil industry to GRP formation.

The research purpose is to additionally justify the conclusions made earlier on imbalance of resource management system in the regions, which influence sustainability of social-economic development using parametric economic-mathematical and statistical analytical methods. The method of the given research is a neoclassic two-factor model of Cobb-Douglas production function, by means of which the effect of reserve increment (RI) and oil production (OP) is estimated on the GRP per capita (GRP_{pc}), which is expressed by the function

$$GRP_{pc} = \gamma \cdot RI^{\alpha} \cdot OP^{\beta},$$

where γ is the technological coefficient expressing the effect of modern technologies in exploration and production on GRP. The parameters α and β are the coefficient of elasticity reflecting the influence on social-economic indicators of reserve increment and oil production. The panel data were chosen for 2008-2018, in this case the inflation was taken into account by means of presenting GRP_{pc} in current prices with respect to GRP_{pc} of 2008.

The results of regressive analysis have shown that common features of the regional development areas follows: a) high level of production engineering facilities due to application of modern methods of exploration and production in all analyzed regions; b) production functions describing diminishing return from increasing reserve increment in all regions, except the Tatarstan Republic; c) significant influence of oil reserve increment on GRP_{pc} growth in the Komi and Udmurt Republics; d) the most significant effect on growth of GRP_{pc} due to oil production is found in the Tatarstan Republic; e) the negative influence of reserve increment on GRP_{pc} is observed in Tomsk Oblast; f) insignificant effect of reserve increment of oil exploration and production on GRP_{pc} is stated in Samara Oblast.

Thus, there search has supported the existing imbalance of resource management system in the regions. In this case Tomsk Oblast is an obvious outsider because of negative effect of existing resource management system of tax incentives for oil production (Sharf, 2019) that allows oil industry to play the role of engine of economic growth to the full extent.

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DYNAMICS OF DEVELOPMENT OF DEMOGRAPHIC POTENTIAL OF THE BORDER TERRITORIES OF THE SOUTH OF THE FAR EAST

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In a situation where the population continues to decline gradually in the Far East, the demographic factor becomes the main one. What is the future demographic development potential and how will the territory's development plans be implemented? In this regard, it is useful to refer to the analysis of the situation at the most detailed level of the study in order to study the existing demographic problems.

In the context of rapidly increasing geopolitical and economic significance for Russia in North-East Asia, it is particularly important to strengthen the demographic potential in the Far East region, especially in the border part. This is especially important for the southern far Eastern territories, both in terms of ensuring the country's national security on its strategically important Eastern borders, and developing the region's economy and cross-border ties. In this regard, the analysis of the demographic situation in the border areas is very relevant today. Along with the geopolitical preconditions of actualization of such studies is also important from the standpoint of economic development based on international relations, visa waiver, tourism development, etc. Such studies are relevant and in terms of ensuring the sustainable functioning of international relations, the importance of which is becoming a significant value.

The dynamics of the region's population is determined by both natural and mechanical movement of the population and, therefore, is the most sensitive indicator of the socio-economic state and depression of regional development. When the population of the region decreases, there is usually a decrease in the number of people employed in the economy. Under the influence of a negative population dynamics that is more pronounced than the national average, any region will sooner or later go into a depressed state.

The study and interrelation of socio-demographic phenomena is related to the analysis of the causes in different regions due to different conditions: the age structure of the population, the ratio of urban and rural residents, or the demographic features that have traditionally developed in the course of historical development.

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FOREST FIRES, LOGGING, AND EVENKI INDIGENOUS PEOPLE

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The forest fires in 2019 in Siberia, when more than 10 million hectares of forest has been burnt across six Siberian and Far East regions, gave a long-awaited impetus to changes in the system of state protection of natural resources. New forest legislation is being prepared.

Forest fires serve as a natural regulator of taiga ecosystems and biodiversity. But with the penetration of industry into the taiga, their frequency and area has increased. The human factor –the careless handling of fire, burning of stubble in spring, and arson, is playing the main role in the occurrence of forest fires. The effects of climate change have played a decisive role in the speed of the spread and area of fires. In Siberia, local residents associate fires and climate change (arid hot summers, frequent winds, shallowing of rivers) with large-scale deforestation.

Fires have moved onto the political agenda from the sphere of climate change and environmental protection. They have become a factor in the internal political struggle, in particular, in Irkutsk. Fires have been used as a political resource by various forces inside and outside Russia, pushing federal and local authorities to strengthen forest conservation policies. Demands for economic and political reforms are also heard.

Forest fires primarily affected residents of the taiga, although there was almost no information about this in the media.The Siberian taiga is home to many small groups of Evenks, both settled and unsettled, and a source of their economic, spiritual and social well-being. Due to the large-scale development of areas of Eastern Siberia and the Far East, the indigenous inhabitants of the forest were the first to encounter problems caused by climate change, industrial development, and the quality of management. Most of them practice sustainable use of natural resources and have a special connection with the taiga. But it would be wrong to imagine Evenks as ideal subjects of environmental management, whose life and worldview are not affected by the influence of the surrounding world. The state has long occupied its niche, along with the spirit masters and other actors in the system of relations between man and nature. Evenki activists participate in environmental, legal, economic, cultural and other practices. Hunters and reindeer herders defend their rights to traditional nature management in the face of strong competitors, for example, industrial companies, and sometimes the state itself. This resistance comes in the form of dialogue and cooperation, which is characteristic of the Evenki relationship with the world. By doing this, they defend their identity, lifestyle, the animals they hunt, the spirit masters of the forest, and ultimately the state itself.

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TYPES AND FUNCTIONS OF MARINE BORDERS IN COASTAL MANAGEMENT

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The classification of the marine part of the coastal zone for the coastal-marine nature management by the sea depths is the purpose of our study.

The main objectives of this study:

1. To show the effect of depth on the spatial distribution of marine economic activities types.
2. To determine the maximum sea depth which limiting economic activity and their diversity.
3. To identify the zones of economic activity concentration in the Russian Far Eastern and Arctic seas by the actual use of the water area.

The boundaries of the coastal zone do not have uniform definition and can be set depending on the research objectives. Geomorphological definition of coastal zone is mainly used in geographical study (Leontyev, 1961). The coastal zone is a contact geosystem with land and sea areas involved in economic activity (Baklanov, 2018). This definition of coastal zone are using for economic studies.

The marine classification of the coastal zone for the purposes of coastal-marine nature management is based on the conditional border of the exclusive economic zone of the state, and according to the geomorphological position, according to the width of the sea shelf. But, the resources of the shelf of the World Ocean are heterogeneous and the conditional marine administrative border is different, so the depth of the sea acts as a justified criterion for functioning zones of nature users identifying for marine nature management.

The diversity of coastal-marine nature management types depends on the length of the sea shelf and the spectrum of natural resources that may be used or already involved in economic activity. For the Far Eastern seas, it was found that the maximum density and variation of sea transport is observed in the offshore zone (up to 200 km from the coast). The greatest depths (more than 1000 m) are not an obstacle to the transit routes of various types of sea transport, but they limit the extraction of biological and mineral resources in the Far Eastern seas of Russia. It should be noted that fishing vessels in these seas are ubiquitous, but their the most concentrations are observed in marine areas with depths of 200-400 m. The most bio-productive fishing regions of western Kamchatka coincided with the areas characterized by the highest density of sea transport.

Passenger and recreational types of sea transport are concentrated in the waters near the southern coastal urban agglomerations and large industrial shore areas of the Sakhalin island Large-tonnage cargo is transported along the coast of the Pacific coast without going beyond the coast and concentrating on water areas with depths less than 200 m(transportation of goods and mineral resources). International transit routes are carried out according to the principle of the shortest distance between departure and arrival points, therefore the water area here is not a factor limiting sea cargo transportation.

Thus, the depth of the sea is not only a limiting factor of coastal-marine nature management, but also it is criterion for classifying and high-lighting the marine border for nature management by accessibility with a direct zoning of the spatial use of the sea by various types of economic activity.

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OPTIMIZATION OF ECOLOGICAL-BASED ENVIRONMENTAL MANAGEMENT

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In the current economic and geographical approaches to the analysis of regional development processes, environmental management is not directly considered, despite its basic role (Baklanov, 2019). However, natural wealth is not automatically a factor in sustainable development. The well-being of a natural-resource-rich territory will depend on how its natural capital is used. This applies more to minerals. Mining is not sustainable, but revenues from that segment can be invested in other forms of well-being such as infrastructure, human capital, renewable natural capital to form an economy that is sustainable. It is particularly important to have a clear governmental policy to invest resource rents in assets. For this purpose, an appropriate management system must be established, which provides information transparency throughout the chain of income generation from licensing and mining to their distribution (Changing Wealth of People, 2018).

The influence of the factor of mineral and raw materials resources depletion on the parameters of socio-economic development of the territory of raw materials specialization was carried out by us for Tomsk region in the sphere of oil resources. High demand for hydrocarbons contributes to increasing their production in the regions, which actualizes the problem of distribution of rental revenues from mining between the federal budget, regional budgets and subsoil users. Calculations of the socially hazardous depletion of reserves can serve as an information basis for justifying a compensatory approach to the distribution of mineral revenues, taking into account the need to reinvest part of natural rents in the socio-economic development of a territory.

The development of the oil and gas complex requires the expansion of development areas, but often, the complete disappearance of ecosystems is not taken into account. In this situation, renewable natural resources become limited, and in some places there may be a "point of no return" when they become non-renewable. The methodology of natural capital assessment allow to determine the maximum full cost of natural landscapes and natural objects in order to optimize the process of environmental management, which implies taking into account the interests of the population and preservation of ecosystems.

The study of interaction between nature and society from the perspective of the concept of natural capital of the Territory in the conditions of a market economy can be considered as a new direction of economic and geographical research of problems of spatial and temporary organization of human activity, development of sustainable environmental management strategies, green economy and regional development, as well as optimization of ecological-oriented resource supply of natural resources management and sustainable development of transboundary territories.

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SOCIAL SECURITY OF IRKUTSK REGION

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Ensuring security is the main task of the state social policy. One of the most important priorities and strategic goals of security in the context of sustainable development is to increase the level and quality of life of the population. On the example of the Irkutsk region, the basic parameters of the standard of living of the population are considered, which determine the low level of security in the region and serve as a criterion for the ineffectiveness of the state social policy.

Irkutsk region continues to be one of the main economic territories of Siberia. In 2017, as in 2000, the region is located in the twenty leading regions among the subjects of the Russian Federation according to the most important macroeconomic indicators: gross regional product, investment in fixed assets, profitability of enterprises, etc.; its relative self-sufficiency remains – the share of own revenues in the consolidated budget is more than 80%.

Despite economic development, the region is located in twenty of outsider regions in the social sphere. The average monthly wage in 2000 was 121% of the level in the Russian Federation, in 2017 the values became equal (97%); the level of per capita cash income in 2000 was 104% of the level in the Russian Federation, in 2017 – 73.7%; the purchasing power of cash incomes of the population on average in the Russian Federation grew 1.7 times (from 1.9 in 2000 to 3.3 times in 2017), in the Irkutsk region – 1.4 times (from 1.6 to 2.3 times respectively). As a result, in the region there is an excess of the average value in the Russian Federation of the population with cash income below the subsistence level, which in 2000 was 1.2 times, in 2017 – 1.4 times.

Thus, in the Irkutsk region, a discrepancy between the parameters of the standard of living of economic development is clearly traced, which contributes to the formation of a low level of social security of the population.

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DEMOGRAPHIC DYNAMICS OF CITIES IN TRANSPORT CORRIDOR (ON THE EXAMPLE OF SIBERIA AND MONGOLIA)

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The subject of this study is the spatial and temporal dynamics of the population in the urbanized areas of the Siberian-Mongolian transport corridor. The model testing ground is the territory of South Siberia and North Mongolia, along which the railway line connecting Russia and Mongolia from Irkutsk to Ulaanbaatar passes. The units of observation taken for the research are urban districts and municipal districts in Russia, and the capital city and aimags in Mongolia. The distance between the main cities by rail makes 456 km (Irkutsk - Ulan-Ude), and 657 km (Ulan-Ude - Ulaanbaatar). The population of the main cities in 2020 is 624 thousand people in Irkutsk, 439 thousand people in Ulan-Ude, 1445 thousand people in Ulaanbaatar(2019). Urban population growth in the period between 1990 and 2020 was, respectively, +7% (in Irkutsk), +23% (in Ulan-Ude), +169% (in Ulaanbaatar). Pulling the population into the largest cities and suburban areas leads to the depopulation of the entire vast periphery and semi-periphery near the main railway. Small-sized urbanized areas of intensive development are distinguished in the form of a broken chain along the highway.

Official statistics give a picture of the administrative-territorial observation units for Irkutsk and Ulan-Ude, without taking into consideration the peculiarities of the people's settlement and the suburban population, and for Ulaanbaatar, within the official borders, it includes unpopulated territories that are many times larger than the area of the city itself. To map densely populated areas (urbanized areas), night satellite imagery and data from Rosstat and National Statistics Office of Mongolia on the population density of settlements were used. Night satellite imagery data allow identifying spatially expressed socio-economic phenomena, such as population density of a territory. As a result of image processing, maps are created that reflect constant light radiation in populated and used territories.

The main urbanized areas were formed in the south of Eastern Siberia along the Trans-Siberian Railway in places with the highest concentration of the population around the regional centers of Irkutsk and Ulan-Ude in Russia and around Ulaanbaatar in Mongolia. In particular, in the Irkutsk region, the main urbanized territory is manifested in the form of a strip with a length of up to 200 km and the width of up to 40 km when crossing Irkutsk, but then it narrows strongly in the north-west direction. The main urbanized part, which includes Irkutsk, Angarsk, Usolye-Sibirskoye and Shelekhov, together with the surrounding villages and rural settlements, has an average population density exceeding 200 people / km^2.

The demographic potential of the Siberian-Mongolian economic corridor is more than half of the population living in the corresponding regions, while it reproduces and receives migrants from peripheral territories. The main promising direction in the development of the settlement system will obviously be the building economic, demographic and social potential in a few centers and areas of their influence during the depopulation of the periphery.

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CHANGE CHARACTERISTICS OF LANDSCAPE PATTERN AND CLIMATE IN WETLAND AREAS OF THE REGIONS AMONG THE "BELT AND ROAD"

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The Silk Road Economic Belt and 21st Century Maritime Silk Road (hereinafter called Belt and Road) initiative was proposed in 2013. The comprehensive protection of the ecological environment of the Belt and Road region for Sustainable Development Goals 2030 (SDGs 2030) presents a challenge. Remote Sensing technology plays an important role in the monitoring and assessment of the ecological environment. The Belt and Road region encompasses a wide area, and its natural environment is complex and diverse. The study on the wetland landscape pattern and climate change characteristics of the Belt and Road is of great significance. Based on the MCD12Q1 Land Cover data and annual temperature and precipitation raster data during 2001-2018. The wetland landscape pattern and climate change character were analysed. Results of this study provide useful basis for the Belt and Road region ecology protection, especially wetland protection and for the scientific implementation of the Belt and Road initiative.

COOPERATION OF THE COUNTRIES OF NORTH-EAST ASIA (ENVIRONMENTAL ASPECT)

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The current stage of integration of the countries of North-East Asia (NEA) in the context of the Russian policy of turning to the east provides a relatively wide range of proposals in economic and environmental activities. We consider the territory of the NEA region as part of six states: Russia, China, Mongolia, Japan, North Korea and South Korea (within the framework of NEASPEC). Environmental cooperation of NEA is carried out on the basis of agreements of a number of large international and regional organizations. Currently, there are about 10 large environmental organizations operating in the region on a relatively harmonized regulatory framework, on a regular basis, whose activities provide real results. Firstly, this is NEASPEC, secondly, TEMM (Trilateral Summit of Ministers of Ecology of China, Japan and South Korea), AUSEM (Summit of Ministers of Ecology of Asia and Europe), MCED (Ministerial Conference on Ecology and Development in the Asia-Pacific Region), ANEARG (Association regional administrations of the NEA countries) and others (Kondratenko, 2016, Russia…, 2019).

One of the «oldest» in terms of time and large-scale projects - NEASPEC (1993), was created in the format of a comprehensive intergovernmental framework program for cooperation in solving environmental problems (following the UN Conference in Rio de Janeiro, 1992). NEASPEC objective: to promote enhanced environmental cooperation in the subregion (Subregional Office for East and North-East Asia of the Economic and Social Commission for Asia and the Pacific - ESCAP, based in Inchon, Republic of Korea). For more than a quarter of a century of its activity, more than twenty reporting international meetings have been held, the last of which was held in October 2019 in Ulan Bator (Mongolia, the author participated as an invited member together with colleagues of the Baikal Institute of Nature Management SB RAS). The main areas of activity of NEASPEC: «Transboundary Air Pollution», «Nature Conservation», «Marine Protected Areas», «Low Carbon City», «Desertification and Land Degradation». Close interaction is observed with the relevant national, sub-regional, regional institutions and organizations of these five states. The real results of three new NEASPEC projects funded by the Russian Federation for monitoring «Big Cats», including the Ussuri tiger and the snow leopard, were highly appreciated. The list of model cities with low carbon emissions («Low Carbon City») was supplemented by new cities, including those proposed by the government of Mongolia (Tsetserleg – the administrative center of the Arkhanlaiaimag and Chingiz – the administrative center of the Khenteiaimag) and the academic community of Russia (Ulan-Ude and Irkutsk).The inclusion of the latter was justified by the author's developments on the environmental safety of Irkutsk, a series of ecological and economic maps of the IG SB RAS, some of which are being carried out for a new atlas for the Baikal region («Baikal region: society and nature»).The new strategic plan NEASPEC (2021–2025) is being developed taking into account the changing global environmental and economic situation during the current year. In the UN international reports on the strategic development of the world economy, the option of transforming the economy by 2050 into a low-carbon, resource-efficient one is considered as the main scenario. Thus, regarding the ecological interaction in the studied region, we can state the period of the renaissance, since the political and legal mechanisms of activity have been formed.

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FEATURES OF THE POPULATION SETTLEMENT SYSTEM IN THE REGIONS OF THE CHINA-MONGOLIA-RUSSIA ECONOMIC CORRIDOR

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In recent years, there has been a reorientation of the priorities of international cooperation to the East of the country, development and strengthening of ties with Mongolia and China. Border regions are a zone of contact with neighboring countries, outposts for the development of cooperation. The emerging China-Mongolia-Russia economic corridor in the near future may become one of the factors of economic development and attraction of the population. The study analyzes the development of population settlement systems in neighboring regions of countries to identify similarities and differences in their demographic development, features and future prospects. Demographic processes act as a kind of indicator of the state of socio-economic processes taking place in the territory.

The study area covers the Inner Mongolia Autonomous Region of China (NM), the central aimags of Mongolia, the Baikal region (Russia). The area of the territory is 3212.0 thousand per km^2 with a population of 32.6 million people. The settlement system of adjacent regions is highly differentiated in terms of natural and geographical conditions, the level of development, socio-economic development and the state of infrastructure. The average population density of the territory is 10.1 people per km^2, so in the Baikal region – 2.8 people per km^2, the central regions of Mongolia – 4.2 people per km^2, NM – 21.2 people per km^2. The highest population density is observed in areas where highways and railways pass. On the Russian side - the areas of the Trans-Siberian railway, on the Mongolian side - the auto and the Sukhe-Bator – Darkhan – Ulan Bator – Zamyn-Uud railway, on the Chinese side - the road and the Ulanchab – Hoh-Khoto – Baotou – Bayan-Nur railway.

The population dynamics is characterized by positive dynamics in Mongolia, the increase was 129.0% since 2000, in the NM - 106.7%, in the Baikal region - a negative growth of 93.7% (Mongolian ..., 2020; China ..., 2019; Rosstat ..., 2019). In the study regions, the population lives mainly in cities and large settlements. In the Baikal region, the level of urbanization is 68.6%, in Mongolia - 67.8%, in NM - 62.7%.In NM, large cities are Hohhot - 2635.0 thousand people, Baotou - 2096.0 (2018), in Mongolia: Ulan Bator - 1491.4 thousand people, Erdenet - 102.2, Darkhan - 86.7. In the Baikal region, the population is concentrated in such large cities as Irkutsk - 623.9 thousand people, Ulan-Ude - 434.9, Chita - 349.0, Bratsk - 229.3, Angarsk - 225.8. The growth of cities is mainly due to internal migration, especially in the Russian and Mongolian territories, the process of depopulation of the countryside is taking place.

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SESSION 3. «TRANSFORMATION AND DYNAMICS OF NATURAL AND NATURAL-ANTHROPOGENIC COMPLEXES AND THEIR COMPONENTS»

METHODOLOGICAL ISSUES TO PRE-ESTIMATE PROBABLY RISKS TO SOCIETY & ECONOMICSDUE TO NATURAL DISASTER (FOR EXAMPLE DENJIINMYANGAOF THE CHINGELTEI DISTRICT, ULAANBAATAR CITY)

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As of 2018, the population of Ulaanbaatar city has reached 1,491 thousand that is 387.4 thousand families due to increasing movement from rural areas city, and around 60% of them belong to gher areas. This survey comprised people living in the territories of 9, 10, 12 khoroos of the Chingeltei district as well as in the vicinity of Denjiinmyanga, for the research of sociology thus estimated their property damages to the caused due to blood risk, explosion dangerous areas of petrol stations & expansion of settlement zones. The expansion of settlement zone of Denjiinmyanga has been determined by 3 factors. 1.Size of territory, 2.Surface slope, 3.Average height of surface. Territories of settlement zones of gher areas have constantly expanded from 1975 to 2010 thus increased by 4.6 times and become 5.6 km^2 as of 2010. To estimate the surface slopes of gher areas, very suitable(less than 3^0), suitable (3-6^0), poor suitable (6-8^0), and not suitable (more than 8^0) respectively. 51.2% of gher area is in very suitable zone, 48.8% - poor suitable and not suitable slope places. Average height of the gher areas settlement zone has increased between 1975 & 2010, that was 1330 m in 1975 and it's been 1510 m in 2010 so the height was of the increase with 180 m. Instructions to pre-estimate damages & risks to be caused to social economics because of natural disasters, blood and explosion risks of petrol stations, and the initial results were ascertained for Denjiinmyanga living area. To make the estimation, the possible danger would hit 717 people of 171 families thus the risk would count 989 million tugrugs.

Finally, based on the assessment, it is proved that certain extent of loss and damages from possible risks is likely to occur when this assessment is calculated in only small areas of Denjiinmyanga of Chingeltei District. As the researches are developed further on, there will be a possibility risks from mountain and rainfall floods as well as risk of petrol station in the vicinity of 6 district of Ulaanbaatar.

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MONITORING OF RECONSTRUCTION DYNAMICS OF AGRICULTURALLY TRANSFORMED GEOSYSTEMS OF THE TUNKINSKAYA DEPRESSION

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Problem statement.

Historically, agriculture is the priority economic sector in the Tunkinskii district of the Republic of Buryatia. At the height of the agro-industrial complex in the mid-70s of the 20th century, the area of agricultural land reached 202.7 thou ha, or 27 % of the entire territory of the region (Deryugina, 1979). The production decline in the agricultural sector in the post-Soviet period was characterized by an increase in the area of abandoned agricultural land and, above all, in cropland as the most valuable resource. The Tunkinskii district has one of the highest values for this indicator in the Republic; from 1998 to 2018, the area of cropland decreased by 56.4% (Atutova, Yekimovskaya, 2019).

Taking into account that without any anthropogenic load, the renaturation processes are activated, the main purpose of our work is to identify the main directions of post-agrarian recovery successions based on monitoring observations.

Object and research methods.

The most agriculturally developed territories of the Tunkinskaya depression are located on gentle slopes of its northern and eastern tips, in the central part, as well as on the western and southwestern slopes of the Yelovskii spur. Currently, the locals of the district are engaged in meat and dairy farming and improving the fodder lands managed by farms and personal subsidiary plots. In the present context, 9.1% of the district's territory is represented by post-agricultural complexes (Atutova, Yekimovskaya, 2019).

We considered the current geobotanical state of 22 areas of fallow lands in order to study the features of natural reforestation after abandonment of agricultural land during the annual monitoring observations of 2014-2018.

Key research insights.

Based on the analysis of the species composition of tree and grass cover of post-agrocenoses, we identified the main options for overgrowing fallow lands, i.e. restoration through birch, pine or mixed undergrowth, as well as meadow succession. Natural reforestation in post-agrarian lands is more intensively along the perimeter of the field and the species composition of the undergrowth is identical to the canopy of neighboring forests. In the grass cover of fallow lands, dominance of meadow species is noted in most cases, while in the ground cover of the surrounding biocenoses, forest species predominate. As a part of the study was confirmation of the dependence of distribution intensity of tree undergrowth on the remoteness from the surrounding abandoned forests land. The more is the distance from the periphery of the fallow lands to the center, the less is the density of overgrowing with tree species.

The main factor complicating the reforestation process is cattle grazing. Regular pasture supports the meadow stage of overgrowing, which can be altered to the tree stage only after the cessation of livestock farming.

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ECOLOGICAL AND GEOCHEMICAL ASSESSMENT OF TECHNOGENIC SOILS OF SVIRSK TOWN

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Currently, among various types of pollution, heavy metals are the most dangerous environmental pollutants. Once entered into the soil environment, the heavy metals (HM) are involved in the circulation of substances, representing a serious danger to soils, plants, animals and humans.

In this study, we used the technogenic soil samples collected close to the former Angarsk Metallurgical Plant (AMP) located in Svirsk town. The plant, being the major enterprise in the town, used to produce arsenic for defense industry. Since 1949, the plant was closed, and the workshops and dumped arsenic wastes were deserted. Starting from 2011, the plant debris and arsenic wastes were dismantled.

The main objective of the present study was to assess the contamination of soil within the industrial site of former AMP in Svirsk town with arsenic and heavy metals.

To assess soil pollution, we performed the ecological-geochemical survey within the AMP industrial site. For this geochemical survey, we used 70 key sites and 2 soil sections. Of those sections, one of them was located around the former arsenopyrite dumps, as they were regarded as the highly contaminated areas with respect to arsenic exposure.

The soil samples were analyzed in parallel with atomic absorption spectroscopy (AAS) using Perkin-Elmer 403 and Perkin Elmer 503 AAS and X-ray fluorescence analysis (XRF) using S4 Pioneer and S8 Tiger X-ray spectrometers (Bruker, AXS).

As a result, soil contamination with arsenic and heavy metals penetrated to the entire territory of industrial site, with As and heavy metal amounts exceeding the Soil Guideline Values (SGV). Of these, the dumped arsenic wastes appear to be more heavily contaminated with respect to As and heavy metals, with their concentrations in the soil around the dumps exceeding the SGV by several thousand times and ranging between 1812 and 8394 mg/kg. Arsenic concentrations were positively correlated with the amounts of other heavy metals: lead (Pb) level in soil varies from 33 to 4910 mg / kg, and the heaviest soil contamination is observed within the area of the former AMP dumps. Similar accumulation trends are observed for Zn, Cu, Co, and Cd.

As regard to the heavy metal and As distribution along the technozem soil profile, there is a general decrease in concentration of elements with depth. The arsenic levels in “A” and “B” soil horizons around the dumped arsenic waste vary between 4650 and 8250 mg/kg, while at the depth of 60-70 cm, its concentrations range from 68 to 158 mg/kg. Lead is accumulated primarily in the upper soil layer where its concentration amounts to 4510 mg/kg, then Pb levels decrease and at the depth of 70 cm, lower Pb concentration (60 mg/kg) has been registered. The levels of Zn, Cu, Co, Cd sharply increase at the depth of 40 cm, which can be likely explained by the fact that the upper soil horizon was brought from outside and was regarded as relatively “clean”. This can possibly result from the migration and immobilization of heavy metals in deeper soil horizons. Therefore, the geochemical survey within the territory of the former AMP in Svirsk town showed that the soil still remains intensively contaminated with heavy metals and arsenic, and can represent a dangerous toxic source of arsenic and metal contamination.

GEOECOLOGICAL RESEARCHES OF TAXONOMIC DIVERSITY COMPOSITION OF SOIL-BIOTIC COMMUNITIES OF SOUTHERN SIBERIA

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In world science, interest has increased in changing the biological diversity of soil biota with increasing anthropogenic stress. The degree of transformation of soil-biotic communities depends on the nature of the use of the territory. It is necessary to highlight the main functions of optimal environmental management, which include: conservation, agricultural, industrial and urban activities, etc. Assessing the diversity of communities allows us to determine not only the number of taxa in a given time interval, in a particular biogeocenosis (which can be used in assessing the sustainability of communities) when environmental conditions of a natural (climate) and anthropogenic nature change. Assessing the impact of such phenomena on the vital activity and the existence of soil zoocenoses is one of the key problems of the ecological functioning of biogeocenoses. Geoecological studies use methodological techniques of various branches of science, in particular geography, ecology, biology, etc. This, on the one hand, contributes to the comprehensive study of research objects, and on the other hand, allows one to find non-standard ways of solving geoecological problems. A comparative geographical approach underlies any classification of objects and natural phenomena. To systematize information on the state of soil-biotic communities, it is necessary to compile special ecological (thematic) maps. This allows us to analyze the obtained results in relation to each other in space, and filling this model with informative data from tables and graphs adds additional advantages to the formation of the substantive part of the analysis on the dynamics of restoration processes occurring in soil-biotic communities. Such a map gives an idea of the current state of the mesopopulation of soils of both natural and disturbed landscapes. The use of a geosystem approach for cartographic purposes allows one to determine the spatial position of the main complexes of soil invertebrates and use soil zoocenoses to monitor the state of the environment. In long-term derivative communities of soil invertebrates, an increase in stability on the action of external factors is observed, and in terms of sensitivity they occupy an intermediate position between disturbed and conditionally undisturbed geosystems. Dynamic transformations of the structural and quantitative characteristics of soil mesopopulation are associated with restoration processes occurring with all components of biogeocenosis. Successions, representing a successive change of one facies to another, aimed at the formation of cenoses characteristic of this region, are among the most important components of the dynamics of geosystems. The numerical characteristics of soil invertebrate communities during the restoration processes also change in the direction of increasing the average number and bio-productivity of soil invertebrate communities, and at the final stages these indicators even exceed the background values. This is due to the restoration of the functional trophic structure of biogeocenoses and an increase in internal interspecific competition. The average biomass of invertebrates is one of the most important dynamic characteristics of soil zoocenoses, which makes it possible to determine the biological productivity of communities, to determine the rate of restoration processes when changing restoration successions, and also to assess the level of changes in the biogeocenoses of geosystems in Southern Siberia. The results of statistical analysis allow extrapolating data to unexplored territories that have similar landscape and environmental characteristics. The spatial patterns of change in the quantitative characteristics of zoocenoses are determined mainly by the latitudinal-zonal features of the climate. The anthropogenic factor, its influence and the "conversion depth" from the landscape structure, phytocenosis composition, exposure features, meso- and microrelief have a significant effect on soil zoocenoses. The reaction of soil invertebrates to changes in environmental factors is manifested, including changes in the functional trophic balance of invertebrate groups, and a decrease in the risks of outbreaks of single-dominant species of large phytophage insects.

ECOLOGICAL FRAME STEPPE LANDSCAPES OF THE TRANSBOUNDAR REGION OF ALTAI

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In the process of economic development of the territory of the Altai territory and Kazakhstan, the natural frame of steppe landscapes was significantly violated. Previously, it consisted of areas of steppes untouched by human influence. Currently, only specially protected natural areas (SPNA) of various types can be classified as such: nature reserves, reserves and monuments. Unfortunately, they are separated from each other by agricultural land and don`t form a complete system that is resistant to external influences. This determines the need to create conditions for partial restoration of natural steppe and optimization of agricultural landscapes based on the construction of their ecological frame.

The ecological frame of steppe landscapes, in addition to protected areas, may include recreational territories, agricultural lands (pastures and hayfields, hunting farms, etc.), forest belts, forest Fund lands, including forests for economic purposes, and other natural and anthropogenic objects with a sparing nature use regime. The most important elements of the ecological frame of steppe landscapes were areas of forest vegetation. Significant reduction of their areas on the territory of the steppe zone of Kazakhstan and the Altai territory in the XX century (V.I. Baranov, G.G. Sokolova) caused the activation of a complex of negative processes: increased deflation at a wind speed of 9 m/s, the occurrence of dust storms and at a wind speed of 15 m/s, loss of soil moisture and reduced productivity.

Attempts to create artificial plantings have improved the environmental conditions of agricultural landscapes. These plantings contributed to a decrease in wind speeds, snow retention in the fields, and a decrease in evaporation during the summer season. But in dry years (1925, 1936, 1963-1965), artificial plantings reduced their area. At present, less than half of the forest beltshave been preserved in the steppe.

Among the reasons for the death of forest belts, S.I. Kukis and V.I. Gorin (1973) found: poor quality of planting material, non-compliance of the design of forest belts with their functional purpose, violation of the technology of tree planting and insufficient care for them. But the main reason was not named – it is unfavorable for forest growth environmental conditions of the steppes. The choice of white poplar (Populusalba) and black poplar (Populusnigra) as the main planting material was due to the high growth rate of these trees and their resistance to pollution. But, poplar lives in river valleys, has a surface root system, so it suffers from a lack of moisture on watersheds. Intense and prolonged drought leads to the drying of the tops and the death of plantings from it.

Currently preserved sections of forest beltsare confined to lake terraces, elements of the water-erosion network and suffusion wells. The percentage of remaining forest belts increases as the average annual precipitation increases. Artificial forest stands of larch, pine and birch have the best survival rate.

In the steppe zone of the transboundary region of Kazakhstan and Altai, at least half of the area should be allocated to the elements of the ecological frame. This can be hayfields and pastures, but in compliance with the rules of grazing animals and rules of haymaking. Their area can be increased by creating protected areas of international significance. These may include national parks, biosphere reserves, and transboundary environmental corridors.

ANTHROPOGENIC TRANSFORMATION OF ARID LANDSCAPE COMPLEXES OF THE CHECHEN REPUBLIC

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Regional differences in the territory of the Chechen Republic of environmental problems are due to the overall level of man-made loads (land use type and population density) and the peculiarities of natural conditions (temperature, precipitation) of the region, that determine the "response" of the natural environment to the man-made load. High anthropogenic impact is on the Central areas, where all urban settlements are located, including the capital of Grozny and all the cities of Gudermes, Shali, Urus - Martan, Argun, Kurchala and large rural areas with a population of more than 10,000 people: Mayrtup, Mesker - Yurt, Geldigen, Tsotsi - Yurt, Autura, Goyta, Gehi, Valerik, Katyr - Yurt, Achhoy - Martan, Alhan - Yurt and others.

The unique landscape complex of the Central regions of the Chechen Republic with comfortable natural and climatic conditions of a fairly high degree of mastery was on the verge of loss of natural stability. As noted by almost 90% of the population of the Chechen Republic, more than 80% of arable land has been developed, an agro-industrial suburban complex with the production of milk, meat, vegetables, fruits, and a large greenhouse complex is functioning.

Naturally, the natural landscape complex has minimal preservation and it is on easy to develop places The ecological situation was particularly severe for the geo-ecosystems of Grozny, the most affected area, where refineries and chemical plants were located, the situation is aggravated by the fact that the city is located in geomorphologically closed space - a basin where pollution stagnates in the atmosphere for a long time, the natural renewal of atmospheric air is slow. Restoration of the country's natural and raw materials base in a short period of time requires the needs of the development of the economy of hydrocarbon resources, raw materials for the construction industry reserves of groundwater. Despite the limited natural resources, this factor is generally beneficial for the development of the Chechen Republic's economy in the near and distant future. Those who have mineral reserves, with rational use and possible increases in their explored and affordable resources, according to experts, will be enough for years to successfully solve the problems facing the economy Republic.

Prospects for the growth of reserves of major natural and raw materials are determined for hydrocarbons – a possible increase in oil production by 2025. in the interval up to 2.6-4.5 million tons (associated gas – respectively 0.9-1.6 billion m^3), or 146-252% to the level of 2003; raw materials for the production of building materials – the scale and pace of restoration of destroyed social and production facilities, for groundwater (primarily fresh water) - reaching the level of 1990. use of groundwater for the water supply needs of the population.

Conclusions:

- the main areas of socio-economic development and solving the most important tasks in the long term, the achievement of which can achieve the goals and eliminate the problems;
- to conduct a full inventory of the state and revaluation of reserves in all mineral deposits in the next 1-2 years;
- resumption of exploration aimed at economically sound reserves in line with projected demand for minerals, especially hydrocarbons and fresh groundwater;
- to conduct a comprehensive geoecological assessment of the environment of the Chechen Republic.

ENVIRONMENT OF THE SOUTHERN PRIMORYE ON THE LATE HOLOCENE

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The coast of the Southern Primoryeis formed by the Holocene accumulative terraces. In areas with active sediment accumulation, in the river's mouth, the height of terraces exceeds to 1-2 m. The climate of the Southern Primorye is moderately monsoon with relatively cold dry winters and warm wet summers. The average annual temperature on the coast is 5.2-5.7oC, average annual precipitation - up to 1050 mm.

Plant cover is composed of low-grown oak trees, shrubs, sedge and forb-grass meadows, and marshes. In vegetation forest type prevails (up to 65%).In the Black Mountains (the system of the East Manchurian Mountains) up to 600 m slopes cover broad-leaved forests of far-eastern type with lianas. Above 600 m forests are represented by mixed broadleaf forests with conifers. The slopes of the ridge are characterized by the mixture of subtropical and temperate flora. There are well preserved massifs of relic black fir-broad-leaf taiga, but the oak forests predominate.

Reconstruction of the environment history on the studied territory was carried out on the basis of a pollen and diatom studies, granulometric analyses and radiocarbon dating of flood plain deposits of Tsukanovka River (Southern Primorye). The section locates at a distance of 1.5 km from of the River mouth on altitude above sea level 3 m. Declivity on this distance is 0,002 m/m. The flood plain altitude above water edge is 1.80 m. The deposits are formed by layering fine-grained loamy sand and brownish-brown clay. At a depth of 130 cm and below dark gray plastic clay lies

Deposits in the interval of 124-140 cm were formed during the Medieval Warm Period (VIII-XIIth years AD). The rise of Sea of Japan for this time is estimated about 1 m higher than the modern one (Korotkii, 1994).The climate was warmer and wetter. The diatom complex characterizes the conditions of the flood plain which subjects to frequent and severe flooding. Wet meadows were common on the delta, partly it was swamped. On the slopes and foothills of the Black Mountains were developed mixed broadleaf forests (*Quercus, Corylus, Juglans, Carpinus, Tilia*,) with the participation of thermophiles (*Fraxinusmanshurica, Kalopanax*), birchs (*Betulamanrica, B*. sect. *Costatae*) and the presence of pines (*Pinusfinebris, P. koraiensis*).The remains of the medieval Bohai city locates on the right flood plain at a distance of 0.5 km from the section.

The deposits in interval 80-124 cm were formed in the first half of the Little Ace Age. The climate was colder and drier than the modern. Forest vegetation reduced. Flooding has decreased. On flood plain forb-wormwood communities were developed. The calibrated date of 1770 years AD was obtained in the interval of 92-97 cm.

Deposits in the interval of 64-80 cm were formed in the second half of the Little Ace Age. The climate has become warmer and wetter than in first half. In forest communities the presence of pines, birch, broadleaf and thermophiles increased again. Flooding has increased. The calibrated gate of 1781 years AD was obtained in the interval of 70-75 cm.

The deposits from interval of 48-64 cm were formed in cool climatic conditions during XIX century.

Thus, the study of sediments of the flood-plain of the Tsukanovka River allowed to reconstruct changes of environment in the Southern Primorye during the last thousand years.

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DYNAMICS OF EXTREME ALLUVIAL EVENTS IN RIVER BASINS IN SOUTHERN SIBERIA

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In recent years, the number of natural emergencies in Russia and in the world has increased. One of the factors initiating the increase in the frequency and scale of emergencies, the importance of which is constantly growing, is global climate change. Modern global climate warming causes an increase in the frequency of extreme meteorological and climatic phenomena and, accordingly, their environmental consequences. An increase in atmospheric humidification and groundwater level in turn also result in negative environmental changes. In certain extreme weather years, such processes in the basins under consideration become catastrophic and destructive.

Years of extreme manifestations of erosion processes were distinguished by long-term data on the suspended sediment yield in 23 river basins. The criterion for the extremeness of the processes is the value of the modulus of suspended sediments yield with a supply not exceeding 15% When considering the chronology of extreme events of suspended sediment yield, their relationship with river flow extremals is established. Based on the study of the difference-integral curve of water flow and suspended sediment in the basins over the last 50 years of the 20th century, the extremals of suspended sediment are associated with secular cycles of increased water content. In the Angara basin, phases of increased water content and, consequently, intensification of erosion processes were registered in 1906–1921, 1930–1952, 1959–1975 and 1983–1995. In the Selenga basin, the increased river water content and intense basin erosion were observed in 1959–1973 and 1984–1995.

The zero phase progression of water runoff in neighboring river basins of the south of Siberia predetermines the formation of regionally significant extremals of the suspended sediment yield. For Transbaikalia, a regionally significant activation of erosion processes, which covered the basins of the Barguzin, Uda, Chikoi, Khilok, Onon, Ingoda and Shilka, was recorded in 1962. It was caused by positive anomalies of precipitation (Borzya, Ulan-Ude, etc.), and almost on all rivers coincided with high floods. The extremals of suspended sediment yield confined to the last phase of increased water content of the 20th century and observed in 1985 (Uda and Onon), in 1988, 1990, and 1998 (Khilok, Chikoi, Borzya, Shilka and Onon) are of regional importance for Transbaikalia.

To identify the hazard rate of erosion processes, we estimated the probability of suspended sediment yield formation of various intensities, which allowed us to subdivide the natural risks of erosion process manifestation as: acceptable (modulus of suspended sediment yield $\leq$ 15 t/km^2 per year), significant (15-30 t/km^2 per year), extreme (30–50 t/km^2 per year) and catastrophic (more than 50 t/km^2 per year). Of especially high probability of catastrophic erosion development is the Angara basin. In the Selenga basin, it is possible in small river basins formed by easily eroded soft grounds, as well as on the rivers of the Upper Amur basin with a probability of 4%.

In accordance with the background forecast for fluctuations in the flow of Siberian rivers, it is possible to outline the beginning of the next phases of increasing river water content and the intensity of erosion processes. Attention should be paid to the possibility of using the consistency of catastrophic storm floods on Siberian rivers with solar activity cycles in the forecasts. We should note that in 80% of cases, the maxima of suspended sediment yield on the rivers of southern Siberia gravitate to the minima of solar activity cycles.

ECOLOGICAL STATE OF SOILS OF CENTRAL CITIES OF URBANIZED TERRITORIES OF THE IRKUTSK REGION, BURYATIA AND MONGOLIA

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Polluting plants have been operating in Siberia for decades. Overall, there are 1/3 cities in Russia with the strongest degree of pollution in the region. The main soil pollutants of urbanized territories in Siberia are heavy metals, petroleum products and their highly toxic derivatives. The most powerful sources of soil contamination by heavy metals in cities are non-ferrous metallurgy mills, and in rural areas mineral fertilizers containing these metals as impurities.

The main sources of pollution in Irkutsk include: factories, TPS, boiler rooms, motor transport. 20 km from the city there is a Irkutsk aluminium plant and other industrial enterprises. Weak wind activity makes the environmental situation worse. However, the structure of the relief determines the probability of the transfer of pollutants of the Irkutsk-Cheremhovsky agglomeration by air flows along the Angara Valley to Lake Baikal. In soils, F, Al, Pb, Mn, Cr, Co, Ni, Ba, V, Be accumulate, as a consequence of industrial emissions into the atmosphere. Their concentration is 3-20 times higher than the background concentration. Maximum concentrations of Ni, Cr, V, Mn, Pb exceeding sanitary and hygienic standards (MPC) are noted on elevated forms of relief. The total area of soil pollution from the Irkutsk-Cheremhovsky territorial industrial complex is extended from the south-east to the north-west by 60 km with a width of 10 - 15 km.

Contamination of the soil of the territory of Ulan-Ude is due to the substance coming from dust and gas emissions from industrial enterprises and gas emissions from motor vehicles. On the territory of the city of Ulan-Ude there is a hotbed of pollution in the central part of the city and a number of smaller areas with high and very high levels of soil pollution Pb, Cu, Zn, exceeding the MPC.

One of the main sources of pollution in Ulaanbaatar is the thermal power complex, where brown coals are burned. In the soils of the city there was an excess of sanitary and hygienic standards on the content of Zn, Cd, Pb, Ni, Cu, which is connected with emissions of motor vehicles, thermal electric stations and furnace heating. Increased concentrations of Co, Cr in soils exceeding background values have been established, which is due to the yield of clay shale.

A map of soil degradation and contamination in the Baku region (Belozertseva et al. http://atlas.isc.irk.ru, 2017) has been drawn up on the basis of many years of research. The map shows the natural hazards of soil contamination. Areas of soil contamination exceeding MPC, gross emissions of pollutants, industrial sources and their contribution to atmospheric pollution were noted. The conditional signs show the lands of the mining industry. The degree of land degradation of agricultural land has been noted.

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DYNAMICS OF SOIL BIOTIC COMMUNITIES IN GEOSYSTEMS OF BAIKAL REGIONUNDER INFLUENCE OFANTHROPOGENIC FACTORS

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The study of the dynamics, functioning and stability of natural systems in the global anthropogenic transformation of landscapes is one of the most actual tasks of contemporary geography and ecology. The scope of the multifaceted cenotic activity of animals is largely determined by the spatiotemporal organization of the communities, by the nature of the intra-landscape relationships, and the geographical limits of their manifestation.

Complex landscape-ecological investigations were carried out at polygons and model territories, reflecting a regional-zone spectrum biogeocoenoses – from a dark coniferous taiga to the steppes in territory of a southern part of Siberia. At statement and realization of works the standard methods of soil-ecological and biocoenological investigations with using of the comparative-geographical approach.

The main reason for the impoverishment of communities and species extinction is increasing human impact on the environment: of industrial enterprises, elimination of tree as a result of felling, fires, overgrazing, plowing of meadows and copses, reclamation, unnormalized use of fertilizers and pesticides, recreational load, and many others, as well as collecting and intense gathering of rare and the most beautiful species.

All this leads to the conversion, reduction, and sometimes complete degradation of habitats of animals, and even to the destruction of the least sustainable ecosystems.

Transformation of pedobionts communities conducts to decrease of a species compositions, diversity and reduction of biotic complexes, that in a consequence will have a negatively effect on biological activity and stability of soil ecosystems.

The deficiency of a soil moisture atwood-cuttings in a combinationinfringement of a soil cover conditions negative effects onsapro- and zoophagus. The density of populations of dendrophagusinsects among functional – trophicgroups is considerably icreased.

The radical changes of structure of biotic communities are submitted at wood-cutting areas after a fire. The change of ecological conditions at burnt-over land is so essential, that for the majority of invertebrates they remain unsuitable within many years. There is reorganizationof communities structure: both a reduction of a species diversity and increase ofphytophagus number and their biomass underantropogenic transformation of natural coenoses.

A comprehensive study of the ecological state of urbanized geosystems was conducted. A comparative analysis is given of the structure of zoocenoses, prevalent in the area of natural and anthropogenically disturbed soils. A negative impact of the urban pressing on the diversity and quantitative characteristics of invertebrate mesopopulations was revealed.

The degree of disturbance of soil-biotic communities in the Baikal region varies significantly: from poorly disturbed (grassroots fires, weak grazing, etc.) to medium and severe (top fires, logging, insect pests, haymaking, recreation, heavy grazing, etc.) disturbed and radically transformed (plowing of land, urbanization, coaland other quarries).

The structure of invertebrates communities and its changes due to the anthropogenic impact may serve as one of diagnostic criterion of soil conditions and can be used for bioindication of an extent of landscape's transformation and for monitoring. Mechanisms of anthropogenic transformation in most situations are a change in either physico-chemical properties of soil or hydrothermal regime, which causes corresponding changes of biotic communities. The negative aspects of these changes are determined by structural and dynamic nonequivalence of landscape units, and by a scale and degree of anthropogenic impact.

INFLUENCE OF FOREST FIRES ON MOUNTAIN-TAIGA GEOSYSTEMS

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Forest fires have become Russia's national disaster. In the Irkutsk region, with its vast territory and low population density, the situation is even more complicated. In 2019, more than 1 thousand forest fires occurred in the Irkutsk region and almost 1.5 million hectares of forest were completely burned out.

Fires are one of the most important factors affecting the composition, structure and development of mountain taiga geosystems. Their natural diversity consists mainly of the various stages of post-fire successions. The reactions of vegetation as the main component of geosystems to forest fires manifest themselves in different ways. Fundamental changes are taking place in the processes of natural reforestation, growth, development and productivity of tree species. A series of post-fire vegetation shifts stretches for centuries. Primary burns, as a rule, are well renewed, most often with a change in softwoods, but often without a change in species, especially in light coniferous forests. Repeated passage of fires in the same place leads to the degradation of growing conditions of vegetation and animal habitat, and often causes a complete loss of the soil layer and, therefore, a huge part of bio-productivity. In such areas, the restoration of biopotentialis sometimes delayed for centuries.

Sustained general fires cause a change in forest species, vegetation, contribute to water and wind erosion, worsen the flow regime in rivers. In wet and moist forest types, waterlogging processes occur, mudflows, snow avalanches and landslides intensify on mountain slopes, flora, fauna and the structure of the entire biocenosisare change.

The objects of research are mountain taiga geosystems, areas of burns of various prescriptions on the territory of the western macro slope of the Primorsky ridge. The ridge stretches for 250 km along the western shore of Lake Baikal and has a maximum altitude of 1746 m on the Trekhgolovygolets. The study site belongs to the drainage basin of Lake Baikal and is included in the Central Ecological Zone of the Baikal Natural Territory. Fires regularly occur in hot and dry periods in the subalpine belt and in all parts of the mountain-taiga belt of the ridge. So, for example, only in the vicinity of Trekhgolovygolets in 2015-2017, about 110 km^2 of mountain taiga and mountain shrub geosystems burned along the main watershed.

Estimates for the long period of formation and functioning of geosystems indicate that due to fires in a significant, and in some landscapes on the predominant part of the forest area, coniferous forests with a high ecological effect are replaced by derivatives, secondary small-leaved forests, the ecological role of which is characterized by a lower index. As a result of this, the ecological functions of forests are decreasing in the basins of watercourses. Snow accumulation, retention of rainfall and moisture content in the soil under secondary small-leaved forests are less than under coniferous ones. Given the magnitude of the impact, these indicators acquire not only regional, but also global significance.

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INDICATORS OF THE ARIDIZATION OF STEPPES OF SOUTH-EASTERN TRANSBAIKALIA IN THE CONDITIONS OF GLOBAL WARMING

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The materials were obtained in the result of the monitoring (2001-2017) of the condition of the components of the northern crio-xerophilous steppes in Central Asia in connection with global warming. Natural observations were carried out both in the territory of Onon-Argun steppe and within the key area of the Kharanorsky physicogeographical station (basic research site in 1962-1980).

The meteorological data of the Borzya station show that, during a 62-year period (1955-2017), the climate of the steppes of South-Eastern Transbaikalia has become drier by 60 mm per year and warmer by 1.4° C. The most significant changes in the steppe landscape components occurred in the first half of the dry period (1999-2001) when the precipitation per year decreased by 50-100 mm and the average annual temperature increased by 1,13°C. In other words, the climate became drier and warmer. In certain years (2001, 2004) the precipitation and moisture content varied between 156-159 mm per year.

Two interconnected groups of the aridization process indicators were determined: the indicators of environmental conditions and those of the response reaction of landscape components. The first group includes such indicators as the decrease in average annual atmospheric precipitation, increase in average annual air temperature, and increase in air dryness. Due to the fact that temperature and humidity refer to the critical components of arid and semi-arid natural systems, the changes that occurred in them produced a negative impact on the water object fed by atmospheric precipitation. That was expressed in the dropping of water levels in the lakes, increase in mineralization, decrease of the lakes' water area that sometimes reached total disappearance. These changes led to the increase in the area of the lakeside salt marshes that became intensely populated by halophyte communities. The decrease of the moisture storage in soil, increased mineralization of soil solutions, dropping of groundwater levels all led to the exsiccation and mortality of the forest stands, transformation of the steppe grass cover caused by the emergence of more xerophilous species. Decrease in the height and density of the grass stand led to the low productivity of steppe and meadow-steppe communities

In comparison with the previous periods (1999-2011), the period from 2012 to 2017 is characterized as more humid (306 mm per year) and warm (1.33ºC compared to an average annual temperature). The atmospheric precipitation of 2012 that exceeded the average annual norm barely affected the moisture storage in soil. Year 2013 was marked by an unprecedented amount of precipitation (520 mm). Heavy rains brought by the monsoons of the Pacific Ocean wetted the soil at a depth of more than 2 meters. Due to that, moisture storage in the layer of 0- 100 cm increased two and a half fold in comparison with a dryer period (94 mm), varying in space from 233 to 254 mm. Abundant flowering of miscellaneous herbs and increasing productivity of herbage were observed in the vegetation cover. The lakes were filled with a higher volume of water whose mineralization decreased fivefold. However, heavy desiccation of soils, which had lasted for 11 years, led to the rapid loss of the received moisture. The lack of atmospheric precipitation in 2014 (211 mm) and 2015 (183 mm) brought the soil back to the state of insufficient moistening at the end of the summer season.

The process of aridization is continuing and, according to the hydrologists of the Borzya meteorological station, the 4-meter deep lake of Barun-Torey covering the area of 580 km^2 that disappeared in 2010 was joined by an even deeper lake Zun-Torey in 2018. The same signs of aridization are also observed in the territories bordered with Mongolia and China.

CHANGES IN THE CARBON DEPOSIT FUNCTION OF WESTERN SIBERIA PEATLANDS AT EXPLOITATION OF OIL FIELDS

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Peatlands are the most significant long-term accumulator of atmospheric carbon on the land. The important climate-forming role of large peatland systems is related to their influence on the regional balance of carbon dioxide, methane, heat and moisture. This report summarizes the results of field studies of carbon dioxide and methane fluxes in peatland ecosystems on the territory of the licensed areas of the Salym Petroleum oil fields (Khanty-Mansijsk Autonomous Region, Russia), the total annual greenhouse gas fluxes and suggest recommendations on the exploitation of oil fields aimed at increasing greenhouse gas accumulation by peatlands.

The results of field measurements of greenhouse gas fluxes were extrapolated for the entire growing season using mathematical models. The net ecosystem exchange is formed as the difference between photosynthetic assimilation of carbon dioxide by plants and CO2 emissions in the process of respiration of plants and microorganisms. Peatland ecosystems with large biomass storages, including those in the tree layer, have significant fluxes (more than 1500 $gCO_2\ m^{-2}$) associated with photosynthesis, but the ecosystem respiration component (750-2200 $gCO_2\ m^{-2}$) is also high. As a result, the highest net carbon dioxide accumulation was observed in the mesotrophic sedge-sphagnum fen and in the treed bog, taking into account the tree layer (603 $gCO_2\ m^{-2}$). The other types of bogs accumulate 244-466 $gCO_2\ m^{-2}$.

The total methane emission from the studied bogs has the highest values (32.6 $gCH_4\ m^{-2}$) at mesotrophic sedge-sphagnum fen. The other types of wetlands are divided into waterlogged (characterized by flux of 7-11 $gCH_4\ m^{-2}$) and relatively dry (with the level of bog waters 20-30 cm below the surface) (flux 4-6 $gCH_4\ m^{-2}$).

Essential fluxes of carbon dioxide and methane were recorded from the surface of the disturbed bogs - clearings along the low treed bog, where, depending on the ground cover, CO2 emission vary in rangee 339 - 1267 2200 $gCO_2\ m^{-2}$, and CH4 emission is 12.5 $gCH_4\ m^{-2}$. An assessment of the regional greenhouse gas balance for an area of 1,497 km^2 showed that in total terrestrial ecosystems absorb about 666 000 t in CO_2 equivalent per year. Forests annually accumulate 558 500 t, and peatland ecosystems absorb a total of 112 800 t.

Despite the fact that the intensity of annual carbon accumulation in forest ecosystems is higher than in peatlands, in the long-term perspective, peatlands conserve more atmospheric carbon than forests. According to the results of radiocarbon analysis of the upper layers of peat, long-term accumulation in the bog ecosystems of the study area is 59 600 t CO_2 per year, and long-term carbon accumulation in the soil of forest ecosystems is estimated at 22 000 t CO_2 per year.

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ECOLOGICAL STATE AND POST-AGRARIAN TRANSFORMATION OF LANDSCAPES (ON THE EXAMPLE OF THE REPUBLIC OF BURYATIA)

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In 2017-2020 comprehensive studies were carried out on the ecological condition and post-agrarian transformation of landscapes in areas where the area of agricultural land in Buryatia (Tunkinsky, Kizhinginsky and Udinsky basins, Selenginsky middle mountains) was most reduced. These lands were actively used until the beginning of the 90s of the twentieth century as arable land. At the time of the study, the former arable land was in a fallow state and cattle were grazed irregularly on them. It has been established that hayfields and pastures are used as natural fodder lands and are not excluded from agricultural turnover. This is due to an increase in the number of livestock in households.

It was found that the agrochemical and agrophysical properties of soils are in satisfactory and good condition. The exception was the key areas of the study with alluvial agro-humus soils with an initial natural low content of humus and basic elements of plant nutrition, as well as a site with an intense pasture load, where an unsatisfactory state of the physical properties of soils was recorded.

Stages of recovery succession of key sections of the study are characterized by restoration of grass, appearance of multi-tiredness, increase of projective coating, increase of species diversity. The exception is arable land located in the bottoms of the intermountain decays of the driest Selenginsky district. Arable land is represented by a degraded rare-earth community consisting of several oppressed plant species. Projective coating is almost completely absent. Features of the relief prevent precipitation.

It has been established that postagrarian landscapes of the middle course of the river. Selengi have a low restoration potential of vegetation against the background of the specifics of the physical and geographical conditions of the research area and the region as a whole. The limiting factor for the return of deposits to arable circulation is the amount of precipitation. A set of measures is needed for reclamation, selection of drought-resistant crops. It is necessary to exclude the use of postagrarian landscapes on alluvial agrogumus soils as arable land. It is recommended to reduce the pasture load and withdraw the areas from the intensive pasture turnover for a period of time (up to 10-15 years). A regulated grazing regime is needed, possibly with an artificial subset of seeds of plant species for ecology close to the natural conditions of the study region. For the vegetation of the landscaped terraces used for hayfields, the timing of fruiting of the main part of the species composition of plants should be taken into account in order to maintain the potential for stable productivity of pasture and hayfields.

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GIS MAPPING ANALYSIS CHANGEABLENESS GEOSYSTEMS OF THE SOUTH-WESTERN TRANSBAIKALIA

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A GIS mapping analysis changeableness geosystems of the site of the Small Khamar-Daban range (south-western Transbaikalia) was carried out. At the same time, the landscape structure of the territory was analyzed from dynamic positions, i.e. the structure of the indigenous and variable states of geosystems reflecting the spatial-temporal changeableness of landscapes. The source of the actual data is the field research of the territory, in which special attention is paid to the dynamic characteristics of geosystems (relief characteristics, species and age structure of the phytocenosis, anthropogenic transformations, etc.). The analysis of the landscape structure is carried out by the methods of visual interpretation and automatic processing of spatial information using GIS technologies based on remote sensing data, field expeditionary studies of landscapes, maps of various contents, as well as literature data. As a result, a large-scale landscape map was drawn up, as well as a series of analytical maps reflecting the different sides of the changeableness geosystems. The analysis revealed the presence of a complex spatio-temporal structure of various dynamic states of geosystems, which is caused both by the influence of various anthropogenic factors and by the influence of the conditions of the location of biogeocenoses.

The key plot is located on a wide planate watershed; it also includes parts of the Temnik river basins on the northern macroslope (Lake Taglei region) and Torei (tributary of the Dzhidariver) on the southern macroslope of the range. The Malyi Khamar-Daban Range belongs to the Dzhida mountain country. The study area is part of the Dzhidinskaya kettle-mountain forest province of larch forests. On the flat watersheds of the study area, the northern slopes of the hills and in the upper reaches of the rivers, taiga spruce-Siberian stone pine-larch vegetation is developed. Within the southern slopes of the hills and in the lower parts of the Torei valley, steppes and larch forest-steppes are widespread. On the wide swampy valleys of streams in the area of Lake Taglei meadow-bog vegetation with plots of yerniks are common. This fact explains the diversity of the natural conditions of the territory and the manifestation of a wide range of landscapes: mountain-taiga, forest-steppe, steppe, as well as meadow, meadow-bog, yernik-bog in the valleys of rivers and brooks.

We identified 3 forest geoms belonging to the mountain taiga groups of the Baikal-Dzhugdzhur and South Siberian geoms, and 1 mountain-steppe geom belonging to the Central Asian steppe landscapes on the study territory. Geosystems are represented by several classes of facies belonging to the following factor-dynamic series: subhydromorphic (along river valleys, streams, intermountain and catchment depressions, in swampy areas), sublithomorphic (on slopes with close bedding of rocks), subhydrolithomorphic (on flat watersheds and near-watersheds areas, planate and elevated areas), xerolithomorphic (southern slopes with rock outcrops), cryohydrolithomorphic and cryohydromorphic (in planate elevated areas and in swamped areas, with the manifestation of permafrost processes). According to the seriality degree, geosystemsare divided into primary, located on flat watersheds and near-watershed areas, planate elevated areas; pseudo-primary, confined to gentle slopes; and serial, which are located on steep slopes with outcrops of rocks, as well as in locations with excessive moisture. In the study area, 4 degrees of disturbance of geosystemswere identified. Conditionally undisturbed geosystems are located mainly in inaccessible territories. The presence of moderate and strong disturbance geosystems is mainly associated with forest fires, local logging, moderate recreational load and forestry. Areas with the maximum degree of disturbance are confined to agricultural lands and residential territories.

THE EXPERIENCE IN THE IMPLEMENTATION OF ADAPTIVE-LANDSCAPE SYSTEMS OF AGRICULTURE IN ROSTOV OBLAST

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Preservation and increase of fertility of degraded soils involves measures to optimize nature management based on scientifically-approved forms of economic activity.

The goal of theadaptive-landscape organization of the territory is to ensure effective protection of soils from degradation during anthropogenic impact. For this, sustainable artificial agricultural landscapes (crop rotation)are formed and rationally used. The task of such crop rotation system is the preservation and restoration of soil fertility. One of the recommended elements of the territory organization in the adaptive-landscape agriculture is contour-strip placement of crops.

We studied the productivity of crop rotation parameters of different proportions of pure steam and perennial grasses to determine the most effective system for a particular agricultural landscape. The experiment wasper formed at the permanent study area located on the slope of the Bolshoi Log clough, Aksaisk district of Rostov oblast in 2016-2019. The experiment was initiated in 1986 in the system of contour-landscape territory organization of a slope with a degree of up to 3.5-4° with a complex of simple anti-erosion structures. The soil of the experimental plot is heavy loam ordinary chernozem on loess like loam. The initial humus content was 3.8-3.83%.

The use of adaptive-landscape territory organization of the slope prone to erosion allowed reducing soil erosion by 33-45%. The use of soil protection treatments as the main tillage reduced soil erosion by more than 11-27%. Soil-protective crop rotations of various parameters, depending on the degree of the slope in the adaptive-landscape system of the agriculture, allow soil fertility to be preserved, and in some areas, restored. For this, it is provided:

- on lands not affected by water and wind erosion, located on a watershed and very gentle slopes up to 1°, crop rotation with 20% pure steam, 20% row crops, and 60% of winter and spring grain crops is recommended. Crop rotation productivity is up to 38 ql/ha of grainunits when applying manure in a dose of 8 tons and mineral fertilizers$N_{84}P_{30}K_{48}$.

- on lands prone to erosion with degree of the slopes from 1 to 2°, crop rotation with 10% of pure steam, 10% of leguminous crops, 20% of row crops, and 40% of winter and spring grain crops, and 20% of perennial grasses is recommended. Productivity is up to 40 ql/ha of grainunits when applying manure in a dose of 8 tons and mineral fertilizers $N_{84}P_{30}K_{48}$.

- on arable lands prone to erosion and poorly eroded areas of degree of the slope from 2 to 3°, an extended complex of agrotechnical measures is applied. Crop rotation with 40% of perennial grasses, 20% of row crops, and 40% of winter and spring grain crops is recommended. Productivity is up to 39 ql/ha of grain units when applying manure in a dose of 5 tons and mineral fertilizers$N_{46}P_{24}K_{30}$, ensuring the preservation of soil fertility at the initial level. With an increase in organic fertilizers by 1.5 times (manure at a dose of 8 tons and mineral fertilizers $N_{84}P_{30}K_{48}$), productivity increases to 43 ql/ha of grain units, and humus content increases to 4.1% (or 7.8%).

- on lands prone to erosion, poorly or moderately eroded soils on slopes with degree from 3 to 5°, it is possible to use crop rotation with a predominance of close-growing crops or perennial grasses as a forage base for animal husbandry.

CHANGES IN THE VILYUI RIVER RUNOFF IN THE FIRST THIRD OF THE XXI CENTURY IN PROJECTED ANTHROPOGENIC CLIMATE WARMING

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It was prepared an assessment of changes in river flow possible in the Vilyui river basin under projected climate warming in the first third of the XXI century based on climate scenarios obtained from an ensemble of selected models of the general circulation of the atmosphere and ocean included in the CMIP3 program (Meehl et al. 2007). The calculations were performed using a version of the monthly water balance model developed for with permafrost conditions (Georgiadi, Milyukova, 2006, etc.).

The Nash-Sutcliffe criterion was used to select global climate models that best reproduce the statistical characteristics of the observed average annual and seasonal values of air temperature and precipitation (Babina, Georgiadi, 2016). From the climate models selected in this way, their ensemble was compiled, which was later used for scenario estimates of average-level changes in air temperature and precipitation.

Previously, calculations of scenario changes in runoff in the central part of Lena river basin were based on an ensemble of global climate models selected for the conditions of the Russian plain (Kislov et al., 2008; Georgiadi et al., 2011). The composition of these two ensembles of climate models differs from each other, but the differences in the average ensemble scenario of climate changes in the first third of the current century, obtained for these two groups of models, were insignificant. Thus, the change in the average annual air temperature within the Vilyui river basin in the first third of the XXI century, in the previous and current ensembles of models was approximately 1.6 ^{0}C for the A2 scenario. For scenario B1, it was in the range of 1.6-1.4 ^{0}C, respectively. And the changes in the annual precipitation amount for scenario A2 were 37 and 23 mm, for scenario B1 - 26 and 15 mm. the Differences in the scenario changes in the annual runoff are hardly noticeable and do not exceed the calculation errors. For the scenario A2 - 6 and 7 mm, for B1 - 4 and 1 mm with an average long-term annual flow in the Vilyui river basin equal to 147 mm.

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SPATIO-TEMPORAL VARIABILITY OF SOIL ORGANIC MATTER ISOTOPIC COMPOSITION IN BAIKAL REGION DURING UPPER PLEISTOCENE AND HOLOCENE

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The results of a study of the carbon stable isotopic composition of soil organic matter in the Baikal region are presented. $\delta^{13}C$ from different-time soils vary from -30.00 to -21.36 ‰, which indicates the formation of their organic matter from C3-vegetation biomass for at least the last 35 thousand years. Fractionation of isotopes during the mineralization of organic matter leads to an increase in $\delta^{13}C$ values with depth. At the same time, in soils forming under steppe and forest-steppe landscapes, an increase in $\delta^{13}C$ is about 3‰, whereas in forest soils it can reach 4-5‰, which is most likely due to a slow transformation of organic residues in the upper horizons of forest soils. In Late Glacial and Early Holocene soils, an increased content of organic carbon is noted, the composition of stable isotopes of which is facilitated in relation to modern soils, which may be due to the influence of permafrost, which slowed down the transformation of organic matter. In the direction from the relatively dry soils of the Olkhon region and Selenga middle mountains to the forest-steppe soils of the Upper Angara region, with its more humid conditions, and further, to the taiga soils of southern Central Siberia, there is a marked decline of the $\delta^{13}C$ values of organic matter, which is a bright example of the manifestation of the dependence $\delta^{13}C$ from soil moisture, namely precipitation of the vegetation period. Reconstruction of precipitation, performed on the basis of $\delta^{13}C$ values of soil organic matter, indicates a gradual aridization of the climate starting from the Late Glacial period with a maximum drying out in the Middle Holocene, and in the Late Holocene the level of humidification increases. The most humid climate was during the formation of early Kargin soils. In the range of about 31-36 kyr BP it has decreased slightly and has become comparable to modern humidity. Moistening of the final stages of the Kargin (MIS-3) time was below the current level.The effect of CO_2 in the atmosphere on the isotopic composition of soil organic carbon is most pronounced when comparing Kargin and modern soils in the form of a significant increase in $\delta^{13}C$ of organic matter towards MIS-3.

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DYNAMICS OF CHEMICAL PROCESSES IN THE AQUATIC ECOSYSTEM OF LAKE BAIKAL (RUSSIA)

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Lake Baikal is of special interest due to the growing shortage of drinking water in the world because the water reserves in this are great. Despite the growing changes in the environment; climate change (warming), the influence of the surrounding industrial enterprises, the influence of the population living on its shores, and the huge tourist flow, it remains clean until now. However, the dynamics of chemical processes occurring in the Baikal ecosystem (Baikal waters, the source of the Angara River and large tributaries) is already obvious.

Baikal is located in the Baikal rift zone characterized by frequent earthquakes and geodynamic movements, during which deep (juvenile) waters flow through active faults, mix with surface waters and are renewed through the processes of upwelling / down welling processes. Moreover, the ability of any water to self-purify is known. The phyto- and zooplankton of Baikal, which is rich in diversity, contributes to this.

We show that the ionic composition of Baikal water and the Angara source has low calcium mineralization (96–98 mg / l) and cyclicity (one cycle in three–ten years), but it has changed slightly over the past 70 years (Grebenshchikova et al., 2019).

Four components represent the chemical composition of Lake: the deep and surface waters of Lake Baikal, the water of numerous tributaries with various compositions and the snow water that flows into Lake Baikal in spring when it leaves the thick snow cover.

At present, it has been confirmed that in the pelagic zone of Lake Baikal, water is the cleanest, which corresponds to the maximum permissible concentrations for drinking water and water for fish reservoirs. In coastal zones, water often contains high concentrations of some elements (Cl. F, U, Be, Cd, Cu, Zn, Pb, etc.), which is associated with the influx of sewage from numerous hotels, campsites and vehicles. The influence of the water on the tributaries is less obvious because most toxic elements stay in areas of their deltas at geochemical barriers.

The water of the tributaries differs not only due to industrial enterprises located on their shores but also the drainage of various deposits and ore occurrences. Therefore, in the waters of the tributaries in the northwestern part of Lake Baikal, where rare-metal mineralization occurs, there is an increased content of Be, F and rare-earth elements. In the tributaries of the western and eastern parts, there is an increased content of uranium in the water. A positive anomaly of europium was identified in the water of the tributaries in the eastern part of Lake Baikal, which is typical of the granitoids of the Angara-Vitim batholith drained by them.

Monitoring of hygiene microbiological indicators revealed constant faecal contamination in areas with high anthropogenic pressure: coastal waters of settlements, recreational objects and estuaries of the lake tributaries. In the pelagic zone and the source, the water mostly corresponded to the drinking water standard (Suslova et al., 2019).

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REPRODUCTIVE HEALTH AND ENVIRONMENTAT THE RUSSIAN FAR EAST: OBJECTIVE CONDITIONS AND SUBJECTIVE ASSESSMENTS

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Given the significant contrasts in environment at the Russian Far East (RFE), even small changes in natural and climatic conditions are crucial for determining the population quality of life (QoL) here. A detailed analysis for Priamurye, located at the southern part of the RFE in the Amur River basin, was carried out as a part of the comprehensive assessment of QoL, with special attention to natural (climatic and biogeochemical), economic and social aspects of environment for women of reproductive age (17-45 years old) (Grigorieva, Sukhoveeva, 2019).

Among the natural factors, the impact of climate on the health of women of reproductive age was studied. The thermal load of the environment on the human body is an important indicator of climate discomfort, which is especially crucial in extraordinary conditions of extreme temperatures at the RFE. A seasonal analysis based on daily mortality rate from all causes of death for women of reproductive age has shown mortality increase with raising temperature in summer. At the same time, the maximum mortality from diseases of the cardiovascular and bronchopulmonary systems is found in November, a period of extreme exacerbations in the weather with maximum variability of air temperature, humidity and atmospheric pressure.

Quality of water was controlled, presenting iron and manganese, compounds of natural geochemical anomalies, are the main pollutants entering the human body with drinking water. The main reasons for the poor quality of drinking water in the region are pollution of water sources supply, the absence of sanitary zones or their inappropriate state, the lack of water treatment facilities and decontamination plants, old equipment, worn-out state of supply lines, the lack of planned major repairs, weak production control, unstable material and technical base.

Analysis of the socio-economic situation showed that currently more than 70% of the population in the study area lives in small towns and villages, characterized by the socio-economic environment which is the worst within the RFE. The leading risk factors and dissatisfaction of the majority of women of reproductive age with the socio-economic development are mainly associated with low income, lack of work opportunities, high unemployment and insufficient level of medical care. As a result of migration and high mortality, these factors lead to changes in the overall structure of the population and their QoL.

Sociological survey demonstrates differences in the perception of environmental threats among women depending on their age. Young women (up to 30 years old) are more tolerant of visible natural negatives and local anthropogenic disturbances. They claim that they grew up in a living environment that allows for such environmental management. However, young women are in solidarity with women aged 30-45 years about the catastrophic consequences of the disastrous flooding on the Amur River during August-September 2019,which resulted in the reduction of fish production as a food supply for their families. It is shown the assessment of QoL of life of women in reproductive age among indigenous people, their specific needs, traditional lifestyles and system of economic activity should be considered.

The current study analyses demographic situation with a focus on women's reproductive health, the quality of the natural and socio-economic environment, provides a comprehensive view on maintenance and consolidation of the population in the eastern regions of Russia. The results can be used by Federal and local governments for demographic practices in regional communities.

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MAPPING OF ANTHROPOGENIC LANDSCAPES OF THE PRIMORSKY REGION

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The pace of transformation of the natural environment by man to his needs is growing from year to year. The area of anthropogenic landscapes relatively natural landscapes increases. The study of the ratio of natural and anthropogenic landscapes in a given territory may be of interest for the purpose of monitoring the state of the environment. Mapping of anthropogenic (anthropogenicly altered) geosystems is an essential component of landscape monitoring technology. The map of natural-technical and techno-natural facies, meso-landscapes, localities or landscapes not only substantially supplements the map of landscape cover, but can also be used independently. Its indispensability is that it is the most comprehensive basis in geographic information systems of various scientific and practical purposes. Such maps are useful in assessing the ecological status analysis of development of the territory, monitoring anthropogenic land cover change, optimizing the use of natural resources.

Consider the ratio of natural and anthropogenic landscapes of the Primorsky region. The area of the study area is 164700 km^2, of which 162000 km^2 are mountain tundra, mountain taiga, mountain forest, forest-forest-steppe and steppe landscapes of accumulative plains and mountain valleys. The total area occupied by anthropogenic meso-landscapes is 16501 km^2 - 10% of the natural area.

These 10% include natural-technical terrestrial anthropogenic meso-landscapes and techno-natural terrestrial anthropogenic meso-landscapes

Natural-technical terrestrial anthropogenic meso-landscapes occupy 433 km^2 or more than 1% of the total area of natural landscapes. This is mainly mid-rise and low-rise buildings for various purposes (industrial, residential, public, inactive), this also includes dams, highways (railways, roads of various categories, airfields, etc.), dumps of industrial and household waste. Regarding the total area of natural landscapes of the region, this is an insignificant value. On a regional scale, these are various urban-type settlements and cities, with all their production, infrastructure and residential development.

Techno-natural terrestrial anthropogenic meso-landscapes occupy 15947 km^2 or less than 9% of the total area of natural landscapes. These include manor and country houses (rural buildings with gardens and vegetable gardens), agricultural buildings (various agricultural enterprises, etc.). Dumps of surface rocks (mainly large mine dumps and quarry dumps). Agricultural production lands (agricultural fields used for cultivation of various crops) are the most numerous, both in terms of the number of contours on the map and the occupied area.

When mapping only technical, natural-technical and techno-natural meso-landscapes and facies, when natural landscapes are not affected, much less labor and time costs are required for creating a geographic information system and preparing a map. This is especially noticeable if the territory under consideration is little changed by human activity. In this case, mapping only anthropogenic geosystems is a very informative express method of assessment, analysis, and monitoring.

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THE GLACIER'S COMPLEXES DYNAMICS OF MOUNTAIN RIDGES OF THE NORTHEASTERN ASIA CENTRAL PART

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Geographical and environmental factors of territorial development opportunities show some perspectives of economic use of glacial landscapes of central part of the Northeastern Asia. Mountain areas in this area in terms of social geography are usually considered mainly as a source of minerals, and, in rare cases, as recreational objects. It is overlooked the factor of glaciation that in the near future can become quite important. Although Siberian mountain glaciers refers to small forms, but in the light of sustainable increase of the value of fresh water it should be pay attention to the Siberian glaciers. They are the potential source of fresh water as the other more large-scale glacial areas. It is important to take into account local climatic and landscape conditions in the study of mountain glaciers which are dynamic and responsive elements of Nature to the any exposure. For Humanity is vital to understand all the features of these natural generators of fresh water, the most valuable resource for the Earth planet.

Glacial areas are interesting to identify trends in glaciations dynamic in view of global warming. Global warming is reviling not only in reducing the circumpolar ice shields of the Planet, but in a condition of mountain glaciers. Small glaciers of south of Eastern Siberia are sensitive to such changes and they can serve as indicators of the rate of climate change. East Siberia's mountain glaciers significantly reduced in thickness for the last decades, and their degradation is slowed in the last 5–10 years. The GIS project and the database of nival-glacial formations for the quantitative analysis of the accumulated information have been created. The mountain region of the central part of the Northeastern Asia (near Baikal rift zone) is an area with a large recreational and informative potential which is not enough covered. The feature of the most remote areas of the region is the presence of modern glaciations. In research areas activity for promotion the methods of cultural and educational contact which include participation of different level of the people in scientific expeditions are conducted by authors. In the article some examples of such cooperation are described. It also provided the information about research territories interesting in both scientific and cognitive and aesthetic and recreational aspects.

Despite the presence of high mountains until the middle of the 20th century it was believed that on the territory of central part of the Northeastern Asia sharply continental climate with little precipitation in winter and quite warm in the summer makes unfavorable conditions for the formation of glaciers and firn fields. In the nowadays, it is found about 150 glaciers with a total area of 50 square km in the mountains of the Baikal Rift Zone. In compare with other mountain regions of Russia where modern glaciations exists Near-Baikal takes fifth place by glaciers' square after the Caucasus (1000 km²), Kamchatka (866 km²), Altai (628 km²) and the Verkhoyansk-Kolyma mountainous country with the Koryak Highland (580 km²).

Glacial landscapes of the central part of the Northeastern Asia can be represented as transect, which spans the various natural areas. This latitudinal transect is the most characteristic continental territory without significant anthropogenic and oceanic influence. In the north, the transect starts from the ridge Kodar and passes to the south-west through the Baikal and Barguzin ranges to the Eastern Sayan.Glacial objects on transect are the small forms of modern glaciation which are most vulnerable to climate change. The consideration of the behavior of mountain nival-glacial geosystems will reveal some of the global and regional patterns of climate variability.

INTEGRATED QUALITY ASSESSMENT OF URBAN ENVIRONMENT: A CASE STUDY OF THE JEWISH AUTONOMOUS REGION, RUSSIA

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Urban areas of the Jewish Autonomous region are structured according to classes of environment quality and level of ecological and hygienic status, by using both integral and differential indicators. The integrated rate of environment quality was obtained by summarizing data on individual components of the environment (water, snow, soil, plants) for the period 2018-2019. In general, toxic elements that pollute the environment are ranked as follows: Fe>Zn>Mn>Cu. In snow, the content of heavy metals, primarily zinc, significantly exceeds the TLV. In soils, the maximum permissible concentration of Fe was exceeded up to 12 times, Pb up to 3 times, Cu up to 2 times, Zn up to 2 times, Mn up to 1.3 times, Cd up to 2 times, Ni up to 2 times. In plants, iron content exceeds the TVL 3 to 8 times; the concentration of manganese was 2 to 7 times lower than the background. The quality of drinking and surface water has deteriorated in 2019 in comparison with 2018, due to heavy flooding in July-August 2019 in the Middle Amur Lowland. Quality of drinking water with unsatisfactory chemical indicators was 72% in Smidovich, 47% in Nikolaevka, 64% in Volochayevka, 39% in Peschanoe. The total concentration of heavy metals was calculated, and 5 levels of geochemical anomalies were identified: very high, high, above mean, mean, and low. The best correlation pollutant content was found for soil and plants. The area structure based on quality of environment will serve as a basis for assessing the relationship between environment and population health of a particular region.

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STATE OF THE WATER AND THE BOTTOM SEDIMENTS OF THE IRKUTSK'S RESERVOIR AFTER 60 YEARS OF OPERATION

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The control of the Angara river flow led to the change in the natural processes of the migration of chemical elements in the lithosphere in the southern of the Siberian platform and their transformation in the Angarsk's reservoirs, including the Irkutsk's reservoir which is the main reservoir in the Angarsk's cascade. The Irkutsk's reservoir receives the basic water nutrition from the lake Baikal which serves as the upper pool of this reservoir. The elemental composition of the reservoir water is defined by the composition of the water of the lake Baikal and the intake of substances with the abrasive material. The reservoir receives about 18 thousand tons of elements of the main composition each year. The elements in composition of abrasive material are 80%. Also, more than 1.500 tons of trace elements enter the reservoir. 86% of them are brought from the lake, among which Mn, Cu, and Ni are the leaders.

The hydrological features of the Irkutsk's reservoir do not conducive to sedimentation and retention of elements. The concentration of elements in the water of the reservoir did not remain constant over a period of its operation. The main reasons for these changes are the variations of concentrations in the import water from the lake Baikal and the course of the water level in the reservoir itself. The abrasion processes in the coastal zone and the intensity of the flow of washed-out material into the reservoir are closely related with the course of the water level in the reservoir itself.

The dissolved form is the original form for the water masses of the Irkutsk's reservoir because it is the leading form of elements migration in the lake Baikal. The weighted form in the water of the reservoir appears from the Patronyz settlement to the hydroelectric dam due to the income of the coastal abrasion material. The increase in the total concentration of elements in the water of the reservoir occurs approximately to the Novo-Razvodnoy settlement. The dissolved form becomes the predominant for the elements in the water due to their transition from suspension to bottom sediments in front of the hydroelectric dam on the Solnechniy-Ershyz traverse. The exceptions are the increase of V and Zn concentrations in suspension and the decrease of Ni content in suspension. However, the predominance of Ni content in suspension over its concentration in solution is observed.

The source of the recent bottom sediments formation of the Irkutsk's reservoir is its abrasion coasts formed mainly by the Jurassic sandstones along the left coast and the Quaternary deluvial loess loams along the right coast. The main types of bottom sediments of the reservoir are represented by sands, large siltstones and fine aleuritic silt which occupy 13%, 16 and 2 from the total bottom area, respectively. The average rate of accumulation of sands and large siltstones is 2-3 mm/year, the average rate of accumulation of fine aleuritic silts is less than 2 mm/year. Elements of lithophilic (Mn, V, and Cr) and chalcophilic groups accumulate more actively in bottom sediments, especially in sands and large siltstones. Zn and Pb are leaders among elements. Fe and Ni from siderophile group accumulate less actively in the bottom sediments.

So, the performed studies show that over a period of the Irkutsk's reservoir operation: 1) the intrusion of abrasive material contributes to the change in the geochemical composition of the water; 2) the complex of the recent bottom sediments of the reservoir was formed from the coastal abrasion material; 3) the composition of the water and the bottom sediments of the reservoir reflect the geochemical specialization of rocks of lithosphere in the southern of the Siberian platform.

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THE SOIL TEMPERATURE REGIME OF THE TUNKINSKAYA DEPRESSION

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In recent decades, one of the most important scientific issues is global climate warming (Second assessment..., 2014), which leads to changes in the temperature regime of soils and degradation of permafrost (Pavlov, 2008), changes in vegetation structure, and, as a result, changes in the landscape as a whole.

The study of the soil temperature regime was conducted at 20 experimental sites located at the territory of the Tunkinskaya depression (Southwest Pribaikalye, Republic of Buryatia). The sites are represented by four main soil types: organic, loamy, sandy, and sandy loam. Some sites have been subjected to anthropogenic interference (deforestation, plowing, fires, etc.).

The features of intra-annual temperature dynamics, freezing and thawing of soils were studied based on measurement data for 2011-2019 obtained at experimental sites using atmospheric-soil measuring complexes (Kiselev, 2018). Soil temperature sensors are located on the surface and at depths up to 10 meters. The temperature measurement error is ±0.1°C. The measurement periodicity is 1 hour.

The soil warms up higher during the warm period at sites where the vegetation cover absent. The maximum difference in annual extreme temperatures registered in 2019 at site affected by the fire was 72.2°C at the surface and 8.4°C at a depth of 320 cm. The maximum difference at the undisturbed site (pine forest) was 47.0°C at the surface and 5.4°C at a depth of 320 cm.

Open sites have lower negative temperatures (on average by 2°C) in winter in the top 30 cm soil layer compared to sites with vegetation cover due to more intense radiative cooling at night, and blowing out the snow cover.

Dense vegetation cover have a strong heat-insulating effect and leads to less warming of the soil in summer, and in some cases results in the preservation of permafrost. The difference in the rate and value of soil heating differs significantly for open sites and sites with low sparse forest. However, in winter, the effect of dense vegetation on freezing is not observed.

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VARIETY OF CONIFEROUS SPECIES AND THEIR COMMUNITIES IN NATURAL AND ANTHROPOGENIC CONDITIONS ON ISLANDS OF PRIMORSKY REGION

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The islands of Primorsky region are in coniferous-broad-leaved forest zone and can be considered as local centres of diversity conservation for coniferous species. Most of the islands are in the southern part of the region in the Peter the Great Bay (the Sea of Japan). At present, natural coniferous communities on the study islands are rare, the dominants are mixed broad-leaved forests. It is connected with active economic activity on the islands since the middle of the XIX century. At present, islands are subject to intense anthropogenic impact and need environmental protection efforts. The research was conducted in 2004-2018. The current state of vegetation was estimated on the basis of geobotanical descriptions of vascular plant communities, distribution, frequency of occurrence (abundant 60-100%, frequent 40-60%, common 20% 40%, rare – 5-20%, very rare – less than 5%, single – less than 1%).

Twenty-eight islands are home to 8 coniferous species belonging to 3 families and 5 genera: *Abies holophylla* Maxim. (Russky, Stenina, Popova, Furugelma, Bolshoy Pelis, De-Livrona, Sibiryakova, Antipenko, Rikorda, Shkota islands), *Abies nephrolepsis* (Trautv. ex Maxim.) Maxim. (Petrova, Bol'shoy Pelis islands), *Picea ajanensis* Fisch. ex Carrière (Petrova isl.), *Pinus densiflora* Siebold & Zucc. (Vhodnye, Furugelma, Shkota, De-Livrona islands), *Pinus koraiensis* Siebold & Zucc. (Russky, Petrova, Popova, Skaly Kreyser, Gerasimova, Rikorda islands), *Juniperus davurica* Pall. (Skaly Kreyser, Opasny, Petrova, Putyatina islands), *Juniperus rigida* Siebold & Zucc. (Petrova, Skaly Kreyser, Orehova, Vtoroy islands), *Taxus cuspidata* Siebold & Zucc. (Naumova, Petrova, Gil'debranta, De-Livrona, Durnovo, Stenina, Bol'shoy Pelis, Matveeva, Klykova, Bel'tsova, Orehova, Pahtusova, Lavrova, Moiseeva, Popova islands). The most part of the species has East-Asiatic geographic range. Three species *Pinus densiflora, Juniperus rigida* and *Taxus cuspidata* are included in the Red Data Books of Russian Federation and Primorsky region. Coniferous species have prostrate, shrub or tree life-forms in the study area. The most common species is *Taxus cuspidata*. The highest coniferous species diversity is on Petrova island. The remaining islands have one coniferous species at an island.

Cluster analysis revealed a group of islands with the least similarity with other islands. These are islands with *Pinus densiflora* (southern islands) and *Juniperus davurica* (southeastern islands). Other groups are the southern islands included in the marine reserve and the small islands of the St. Eugenia archipelago with *Taxus cuspidata*; the northern islands and islands included in the Lazovsky Reserve. On the islands of the second group, *Abies holophylla*, *Pinus koraensis*, *Juniperus davurica*, *Taxus cuspidata* are common. The islands are grouped according to the composition of conifers, according to the size of their area and geographical location. Coniferous plantations perform the environment-forming, protective, recreation and other roles. Analysis of the distribution of coniferous species on the islands of Primorsky region confirms the need to assess the state of island territories, their importance for the conservation of coniferous communities. The Naumova and Petrova Islands act as the leading centres for the conservation of *Taxus cuspidata* populations. There are communities of the *Pinus densiflora* on the Vkodnye islands. Large plantations of *Abies holophylla* on Russky Island are represented by artificial plantations, while the plantations of Stenina Island have natural origin. The islands of Skaly Kreiser islands are dominated by the stunted communities of *Juniperus davurica*.

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CLIMATE CHANGE AS A FACTOR IN THE DISTRIBUTION OF CONIFEROUS AND BROAD-LEAVED FORESTS IN THE ALTAI-SAYAN ECOREGION

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The current global climate change is no longer in doubt. The question of the reasons for this process – natural cycling or anthropogenic impact – remains debatable. Climate change makes it more difficult to preserve species and ecosystems in protected areas. There is a need to adapt to this process and, if possible, use it for sustainable development of regions.

In the Kemerovo region, there is a natural monument of federal significance "Linden grove", which is the only area of distribution in Siberia of coniferous and broad-leaved forests with Siberian linden (*TiliasibiricaBayer*). Linden grove is a remnant of heat-loving broad-leaved forests of the tertiary period and serves as a refuge for a complex of tertiary non-moral relics, whose species saturation is the highest among all communities in Siberia – 23 species.

Analysis of the variability of annual temperatures and precipitation amounts based on data from the weather stations closest to Linden grove indicate an increase in the annual air temperature at an average rate of 0.33°C / 10 years and the annual precipitation by 20 mm / 10 years. The results obtained are correlated with the data of the assessment report "Climate Change and its impact on the ecosystems, population and economy of the Russian part of the Altai-Sayane coregion".

Climate change has an impact on all elements of biological diversity, manifested in the following ways: changes in the distribution of species; changes in the time of events in the biological cycle; increase in populations of some competing species in relation to others; distribution of plants and animals that are not typical for this territory.

Modern research shows the quantitative prevalence of different-age undergrowth of Siberian linden over middle-aged individuals on the territory of the natural monument "Linden grove", as well as the appearance of individual plantings outside of it.

Modern global climate change contributes to the creation of conditions for the formation and distribution of coniferous broad-leaved forests in the Altai-Sayane coregion with Siberian linden formations, in combination with coniferous forest-forming species of the region (siberian cedar, siberian fir, common pine, siberian larch).It is also possible to expand the distribution range of rare, endangered and endemic plant species.

A significant limiting and threatening factor is the anthropogenic impact on the protected area "Linden grove". In the surrounding area, open-pit coal mining is carried out, processing plant emissions are produced, country sites are located, and gold mining is planned in the upper reaches of the Big Tesh river, which borders the grove. There is virtually no buffer zone. On the territory of the grove itself, illegal harvesting of ramson, harvesting of pine nuts, felling of Siberian linden, as well as economic felling of fir and aspen are carried out.

The issue of finding ways to preserve the Siberian linden formation as the basis for the formation of coniferous and broad-leaved forests of the future in the Altai-Sayane coregion is relevant. Additional efforts by the scientific community and the public are needed to reduce and prevent anthropogenic impacts in order to preserve the unique ecosystem of the Linden grove protected area.

METHODS OF STUDYING AND MAPPING THE TRANSFORMATION OF GEOSYSTEMS OF GEODYNAMICALLY ACTIVE ZONES (ON THE EXAMPLE OF THE BAIKAL NATURAL TERRITORY)

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Solving the problems of assessing and predicting changes in the environment of regions, improving the quality of the scientific and information base for managing regional development, and understanding natural processes is the basis of modern geographical research.

The task is complicated by the need to study geosystems developing in the conditions of climatic and geodynamic changes that are characteristic of the Baikal natural area.

The research is aimed at solving the problem of evaluation and prediction of transformation of geosystems of a unique region, which are at different stages of evolutionary and dynamic transformation.

For the first time, leading factors in the transformation of geosystems were identified and presented in the report for the entire territory.

This paper presents the results of a study of the transformation of geosystems during the late Cenozoic associated with climate change and environmental conditions. The specificity of the influence of tectonic factors, igneous and metamorphic rocks of different composition on the transformation of geosystems is revealed.

Geosystems of representative areas of the Baikal natural territory were studied: mountain areas of the Baikal rift zone, intermountain basins and zones of development of the oldest rocks on Earth (the "ancient crown of Asia"), the southern ledge of the Siberian platform (the Irkutsk amphitheater), which is affected by the rift zone, and the Eastern Sayan.

The modern geosystems in many parts of the Baikal natural territory was subjected to intense anthropogenic and pyrogenic effects. In this regard, we consider the nature of their transformation and the degree of its impact on the environment of the Baikal natural territory.

The materials will be presented in the form of information synthesis of data and knowledge about the territory, based on the theory of V.B. Sochava's geosystems, the results of ground route research, cartographic information, interpretation of satellite images, and GIS technologies.

The practical and scientific significance of the proposed research lies in the theoretical and methodological results that can be used as a basis for further theoretical research, landscape mapping, scientific support for the tasks of nature management, nature protection, assessment of the ecological state of the area of the unique natural system of Lake Baikal.

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DYNAMICS OF NATURAL COMPLEXES OF THE MIDDLE OB REGION

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Intensive river channel deformations on latitudinal reach of the mid-Ob are an unfavorable process. The issue of secure economic management in the lateral erosion zone is pressing in Russia, specifically in West Siberia which is highly subjected to the negative impact of river channel deformations (Vershinin, Zemtsov, Inishev, 2013, p. 67). River channel deformations are rated as natural hazards related to the stream water action. Stream-bank erosions are most strongly pronounced among them (Zavadsky, Ilyasov, Ruleva and others, 2013, p. 56). Riverbank deformations occur due to the operation of erosion-accumulative systems and are characterized by the formation of watercourse channels depending on the flow water content, channel parameter and shape, sediment run-off, and other characteristics allowing definition of corresponding types of river channel evolution and morpho-dynamic channel types (Chalov, 2013, p. 25). The paper of V.V. Surkov presents the data about average rates of stream-bank erosion for the mid-Ob as 3-5 m/year, and up to 24 m/year (Surkov, 1999, p. 16). This paper uses methods of monitoring over the river channel deformation dynamics on the latitudinal reach of the mid-Ob: a field method using the satellite positioning systems and measurements of bank recession rates by field-established benchmarks; a method of space images interpretation.

Taking into account average annual rate from 2002 thru 2019, the Ob bank edge shifting rate was as follows: in 2002 – 7.8 m/year; 2003 – 2.35 m/year; 2004 – 3.46 m/year; 2005 – 2.89 m/year; 2006 – 4.19 m/year; 2007 – 3.25 m/year; 2008 – 1.93 m/year; 2009 – 2.36 m/year; 2010 – 1.57 m/year; 2011 – 1.51 m/year; 2012 – 0.68 m/year; 2013 – 2.36 m/year; 2014 – 2.45 m/year; 2015 – 5.0 m/year, 2016 – 1.69 m/year, 2017 – 2.57 m/year; 2018 – 2.58 m/year, in 2019 – 1.59 m/year. Long-time average annual bank recession rate by monitored cross section over 18 years equals to 2.8 m/year. The maximum speed of reliction of a brow of the coast is recorded in 2004 and was 17.5 m/year on the fifth alignment. This area is used for economic purposes such as hayfields, therefore it may be concluded that fodder-producing areas are lost. Moreover, monitoring of this site will be helpful in making further predictions related to Ob river channel deformations.

The research is executed on a grant of the Russian Federal Property Fund No. 19-29-0525919 "the Post-cryogenic paedogenesis of the West Siberian Plain" and also with financial support of the Russian Federal Property Fund and Government of the Khanty-Mansi autonomous district Yugra within scientific project No. 18-45-860001 of r_a.

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FEATURES OF THE VEGETATION OF THE OLKHINSKY HIGHLANDS

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The territory of the Olkhinsky Upland is located in the zone of the border between the Central Siberian subtaiga light coniferous and the South Siberian mountain taiga dark coniferous continental plant communities (formations). This ensures the interpenetration of elements of these large coenotypes and leads to an increase in the flora-cenotic diversity within the valleys of the Bolshaya Olkha and Malaya Olkha rivers.

In this territory, the distribution of plant communities is 50% subordinate to altitudinal-belt patterns. Microclimatic conditions reflecting the features of the relief have a great influence on the change in the structure of indigenous vegetation. This is the presence of wide valleys and valleys, vast surfaces of gentle and gently sloping watersheds, close occurrence or outcrops of bedrocks in the form of outliers, kurums and stony placers.

Potentially, without taking into account the anthropogenic factor, the territory is characterized by the predominance of indigenous light-coniferous, dark-coniferous and mixed dark-coniferous-light-coniferous forest communities. In this work, in the classification of vegetation, the indigenous communities were combined into plant associations and groups of plant associations according to similar structural and functional characteristics, as well as to the requirements for ecological conditions.

To date, 76% of the Olkhinsky Upland is covered by secondary or restored long-term-derived plant communities at the site of clear cuttings and fires. These are small-leaved birch, aspen or mixed coniferous-small-leaved groups of associations, associations of duschekiafruticosa thickets, as well as light coniferous pine, larch-pine forests that are in the stage of restoration to primary forests. The network of logging roads, developed in the areas of felling for various purposes, is widely spread. Some of them are not used and are overgrown with pioneer vegetation.

In total, 377 species of vascular plants were recorded in the list of plants recorded in the study area (Yakubenko, 2013). Most of them are angiosperms. Among them, 11 are included in the Red Book of the Irkutsk Region (Krasnaya Kniga, 2010). One of these species – *Listera ovata* - is endangered. Six species are vulnerable – *Cypripedium calceolus, Cypripedium macranthon, Epipogiumaphyllum, Platantherabifolia, Chrysospleniumsedakowii, Orobanchekrylowii*. Four rare species close to falling into category 2 or 1 have been identified: *Liliumpumilum, Calypso bulbosa, Neottianthecucullata, Paeoniaanomala*. Some of these species are outside their ecological optimum

A high degree of disturbance of vegetation by fires, felling and paved forest roads significantly reduces the potential for uniqueness of the territory. The presence of the Trans-Siberian Railway, settlements and horticultural associations, active economic development of the forest, extensive collection of wild plants, as well as the annual increase in the load from tourism poses a threat to many species of plants and their associations.

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QUALITATIVE ASSESSMENT OF SOILS OF AGROLANDSCAPES IN THE EASTERN SIBERIA

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For a more efficient use of soil agrolandscapes at the present stage of development of agriculture requires the development of new approaches and concepts of its management. For example, the concept of adaptive landscape farming, formulated by A.N. Kashtanov (2008) implies a land use system aimed at producing products taking into account economic and material resources and ensuring the stability of the agrolandscape and the reproduction of increased fertility. The basic block in the implementation of this concept is agroecological assessment or soil-ecological soil assessment, which is based on a comprehensive study of all the components of nature.

Soil-ecological assessment of agrolandscapes is currently used in the comprehensive monitoring of soil fertility of agricultural lands (Guidelines for ..., 2003) and actually approved at the government level (Karmanov, Bulgakov, 2012). It involves a qualitative assessment of soils (Karmanov, 1991) based on calculations of soil-ecological indices (SEI), which quantified the natural potential of agricultural lands in points (from 1 to 100). The resulting SEI, as the final value, is determined through the product of soil, climate and agrochemical indices. The indices were calculated using an automated electronic system (AES) developed on the basis of Microsoft Excel (Shpedt et al., 2015). The methodology also allows you to calculate the bonitet points of arable land suitable for cultivation of specific crops. The calculation of the bonitet score of soils of agricultural lands in the Krasnoyarsk Territory showed that the PEI is from 14.7 to 53.8 points, with an average value of 37.3. For comparison: all soils of the Krasnodar Territory have a SEI equal to 100 points (Karmanov, 1991). Alluvial soil has the highest index value, and sod-podzolic strongly podzolic soil has the smallest. Soil-ecological indices of leached and ordinary black soils widely used in agriculture of the region are 50.3 and 46.8 points, respectively. Soils of agrolandscapes of the Irkutsk region are characterized by a low level of fertility in comparison with soils of the Krasnoyarsk Territory. So, the maximum SEI values are 31 points in dark gray forest soils, and leached and ordinary chernozems - 28.4 and 24.9, respectively. It should be noted that the value of the final soil-ecological index is largely determined by soil and agrochemical indices. The climatic index varies slightly depending on the type of soil, and its contribution to the overall soil assessment is leveled.

In general, the soils of agricultural landscapes of Eastern Siberia are 2–4 times inferior in fertility to Krasnodar agricultural soils. What follows is the need for the most thorough study of the fertile properties of regional soils, the development and implementation of agrotechnical, agrochemical and soil protection measures aimed at solving food problems, while maintaining the ecological functions of soils.

TRENDS IN VEGETATION COVER IN THE RUSSIAN PART OF THE AMUR RIVER BASIN IN THE ECONOMIC DEVELOPMENT OF THE TERRITORY

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Basin of Amur River is located on the eastern edge of Asia in the zone of active interaction between the mainland and the Pacific Ocean. This determines the high contrast of natural and climatic conditions, the combination of natural boundaries of plant formations of different phratries and their vulnerability to the economic development of the territory. Risk factors for the plant cover of the Amur region include large-scale fires, continuous plowing of the lands of the Zeya-Bureinskaya and Middle Amur Lowlands, in the upper reaches of the Amur River; cutting of forests; expansion of road infrastructure, mining of non-ferrous metals, etc.

Large-scale development of the Amur Region territory has led to the discontinuity of the habitats of many relict, endemic species, increasing the mosaic of their spatial distribution and the formation of isolated, unstable populations. There is a decrease in the floral and regional ecological diversity of biogeocenoses. A disproportionate load on ecosystems disrupts inter-ecosystem connections and increases the contrast of the environment, making plant communities more fragmented. The number and diversity of new ecotones and emerging young ecotonic ecosystems is increasing, and the ecotonization of vegetation cover is increasing.

Assessing the transformation level of vegetation cover in the Amur basin, based on the complex criteria developed by B.A. Voronov, Z.G. Mirzekhanova, S.D. Schlotgauer (Voronov et al., 1991), four levels of ecological state are identified: catastrophic, critical, stressed and satisfactory.

The areas of cities and their suburbs, major centers of the mining industry (Luchegorsk, Raichikhinsk, Solnechny, Mnogovershinny, etc.), local sections of mountain territories that have been repeatedly passed by catastrophic fires over the past decades are highlighted by the environmental situation of a catastrophic level. Ecosystems have been completely transformed, the indigenous vegetation cover has been completely destroyed and its restoration in a natural way is not possible. The structure, biological turnover and other features of the functioning of vegetation cover are almost completely regulated by man. Directed restoration of vegetation cover in the form of forest plantations, reclamation activities on dumps, quarries, landscaping in localities, etc is carried out.

The critical and stressed level of the ecological situation is characterized by certain sections of the central and southern regions of the Amur Region, local areas on the slopes of the mountain systems Sikhote-Alin, Badzhalsky, Dusse-Alin, etc. The deterioration of the ecological situation is caused by logging, agricultural land use and accompanying fires, which differ in the degree of impact on vegetation cover.

The satisfactory level of the ecological situation is determined for the northern, central and partially southern regions and is associated with a weak development of the territory. These are a kind of "reserve zones" of development, which should remain the same. Their ecosystems are stable, but in some areas they suffer from grazing, recreational loads, etc. Preserved forest, meadow and swamp communities that perform important environmental, water conservation, and biotic functions, with unique relict and endemic plant species included in their vegetation cover, form the core of the Amur Region's conservation complex.

ON APPROACHES TO THE INTELLECTUALIZATION OF THE SCENARIO MODELING PROCESS OF WATER RESOURCES IN THE ANGARA REGION

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In the last decades, computer and software facilities made a significant contribution to advances in environmental science and environmental modeling. In particular, these research areas are recognized as complex and multidisciplinary thereby, they can benefit from modern knowledge engineering methods. Here we present our early results concerning one of the particular problems of environmental modeling: the scenario modeling of water resources state.

We adopt well-established component-based and ontology-based paradigms to describe the scenario modeling process in order to get the related problem-oriented knowledge-based tool at the end. To address this final goal we have to solve the following interconnected problems: define and formally represent information related to water resources domain and scenario modeling methodology; carry out mathematical modeling of considered processes taking place in the water object; design and develop a software tool.

The information about water resources can be obtained from different sources: reference books; official sources of information (registries and cadastres, information funds and databanks, etc.); publications in monographs, journals, and web resources, including monitoring data; information models of water resources and ontologies, in particular. Based on different kinds of information freely available from the open sources we design a prototype of the water resources ontology that also includes a set of instances about objects in Irkutsk region.

The ontological approach is also implemented for describing general scenario modeling methodology, including information about the structure of models, the principles of their development and the methods used. A component-based modeling approach is chosen as the key methodology for supporting the scenario modeling process as this approach provides a high level in flexibility and extensibility allowing to assemble a model from a set of independent functional blocks. As a starting point in this direction, we refer to the existing ontology for component-based models of water resource systems (M. Elag, J.L. Goodall, 2013).

As the main issue for testing considered approaches for intellectualization of the scenario modeling process, the contemporary task of studying the ability of water objects to restore environmental well-being (otherwise called assimilating ability) is chosen. And in this context, the key studied characteristic of a water object is its assimilation capacity. Currently, the model of the mass balance of the conditional pollutant in the form of an ordinary differential *equation*is used as the basic mathematical model. The model can also take into account additional influence factors such as the bottom sediments. The basic model is obtained from the well-known model for calculating changes in the hydrological and environmental characteristics of water objects (V.N. Mihailov, 1998) as well as on the existing author's experience in mathematical modeling of the pollutants distribution in water objects (V.V. Kozlov,2009). The scenario modeling suggests the following types of changes: 1) variations in the values of exogenous variables; 2) variations in parameters that determine the influence of variables on each other; 3) variations of variables in the model itself, including both the values and the actual structure of the model.

The software implementation is carried out on the base of platform for creating knowledge-based systems (O.A. Nikolaychuk, A.I. Pavlov, A.B. Stolbov, 2018). The research results make contributions in solving issues of usage, restoration, and protection of water resources.

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GEOCHEMICAL CHARACTERISTICS OF SOILS OF NATURAL AND DISTURBED LANDSCAPES OF THE TUNKIN HOLLOW

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Soil, being one of the most important components of the environment, performs a number of functions: geological, geoecological, bioecological; bioenergetic, hydrological, meteorological and others. Soil is a connecting link in the cycles of exchange of matter and energy, which determines the relationship in the global mechanism of the geographical environment (Kabata-Pendias, Pendias, 1989, Motuzova, 2009).

The aim of this work is to identify the geochemical features of the distribution of macro- and microelements in soil samples of disturbed and natural landscapes on the territory of the Tunkinsky depression (Buryatia Republic, Tunkinsky National Park). To do this, the gross contents of chemical elements in natural and agrogenically transformed soils were studied: arable land, fallow lands, hayfields and pastures. Soil sampling was carried out in the summer of 2015 and 2016. both by the envelope method according to (GOST, 1983), and by genetic horizons, including parent rocks. A total of 26 sites were laid, 77 soil samples were taken.

The obtained contents of chemical elements are characterized by varying degrees of distribution over the study area. So, Fe, Al, Mg, P, Sr, Zn, and Co are more evenly distributed in the soils of the Tunka basin. Siderophilic elements according to the Goldschmidt classification (Smyth, Joseph, 2012) (Ni, Co), lithophilic elements (Si, Ti, Ca, K, Na, Mn, Ba, Cr), as well as chalcophilic (Cu, Pb, Hg) differ in extremely uneven concentrations depending on type of landscape and type of soil. All obtained concentrations of micro and macro elements are background and do not exceed the maximum permissible concentrations.

The group of chalcophilic elements is represented by Pb, Zn and Cu, which are also heavy metals (HM). With an increase in the mercury content in soils, it is characterized by increased contents of other HM in anthropogenically disturbed soils. In native soils, the inverse nature of the relationship is noted, with a direct connection between the remaining HM.

The group of siderophile elements is characterized by very strong bonds in the accumulation of Fe, Ni, Co, and Hg soils in both disturbed and natural soils. However, in native landscapes, mercury decreases as the remaining elements increase.

Elements of the chalcophilic and biophilic groups are more dependent on each other in the accumulation of soils of different landscapes of the Tunkinsky depression. At the same time, it is worth noting both the direct and reverse nature of the relationship.

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MERCURY IN FOREST FUEL MATERIALS OF THE BAIKAL REGION

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Forest combustible materials, represented by different types of plants and their residues of varying degrees of transformation, are also sources of secondary input into the components of ecosystems as a result of fires of chemical elements. The role of the source of secondary pollution depends on the absorption capacity of plants to accumulate one or another element. The degree of transformation of the element as a result of the destruction of plant residues. Type and intensity of fire. As well as orographic and meteorological conditions, etc. (Scherbov , 2015).

Studies to determine the mercury content in combustible forest materials (needles, coniferous and deciduous trees, litter, peat) were conducted in the Irkutsk region, the Republic of Buryatia. The mercury content in the needles was determined by atomic absorption spectroscopy using a RA-915 + mercury analyzer with a pyrolytic attachment PIRO-915 (pyrolysis method). The accuracy of determination is 5 ng/g. The concentration of mercury was calculated per 1 g of dry matter.

The average mercury content in needles in the study area, regardless of tree species and age, does not significantly differ from each other and varies in the range of 10-12 ng/g, with a maximum of 27 ng/g.

The average Hg content in pine cores in the sample was 12.8 ng/g, and the maximum was 1089 ng/g. At the same time, the influx of mercury into pine wood is more contrasted than poplar wood and, apparently, reflects the features of its accumulation (Malenko, Usoltsev, 2010).The average mercury content in the peat of the Baikal region is 23 ng/g, with a spread of 7 to 44, with a content of 1 to 124 ng/g in mineral soils.

Despite the low average mercury content in the forest combustible materials of the Baikal region, the calculations of the element intake as a result of fires are impressive (Malenko, Usoltsev, 2010).

Table 1

Estimation of mercury content in coniferous phytomass in the Siberian region

Region	CHg, ng/g	Mass of needles, kg	Hg in needles on the territory, kg	Emission in case of fire, kg	
				Grassroots	Upstream
Altai Region	14	12,8	26,2	6,3	13,1
Baikal Region	16		5306,6	1273,6	2653,3
Tomsk Region	68		3481,6	835,6	1740,8

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SOME RESULTS OF AGROLANDSCAPE ZONING OF THE SOUTH OF MIDDLE SIBERIA

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Our research territory is the south of Central Siberia (the Republic of Khakassia and Tyva, and the southern and central regions of the Krasnoyarsk Territory).

The diversity and specificity of natural conditions of the research territory, the possible adverse effects of economic activity define the need for the landscape approach to justify better use of agricultural landscapes in the region. The use of a landscape map, as the basis for creating agrolandscape maps, improves accounting the reserves of agricultural land, not only quantitatively, but also qualitatively, as well as to outline ways of optimal land transformation depending on the natural conditions of their development territories.

The options of rationalizing land use should be based on agrolandscape zoning, reflecting specialization and technology of agricultural productivity due to the differentiation of the natural conditions of the region. Zoning is an essential element of agrolandscape research. Despite the partial transformation of original natural landscape during agricultural development, the natural properties significantly affect the structure, dynamics and functioning of the agrolandscape system. The production components of the agrolandscape, namely, agricultural technology, land composition, agriculture system, land reclamation, etc. interact with the nature, which determines the stability of the system as a whole. Otherwise, this would make it possible to reduce the natural potential of the lands and even their degradation. At the same time, the production component of the agrolandscape allows us to control over the natural processes on cultivated lands to some extent.

When creating an agrolandscape map, we correlated the types of landscapes with the types of land use, crop composition in crop rotation, applied agricultural technology, crop productivity, climatic indicators, etc. The map shows the existing natural agricultural systems. Their characteristics include data on both the natural and agricultural blocks: properties of the components of geosystems; environmental features (zonal-provincial geographical location and agro-climatic resources); current types of agricultural use (types of crop rotation and agricultural complex); and average long-term crop yields.

Thus, the main agrolandscape research task is to study, analyze and assess the current state of natural and anthropogenous landscape, to predict the transformation of the development of geosystems under the influence of human agricultural activities.

The results of agrolandscaperesearch with the use of landscape analysis of the agro-natural potential of the geosystems of this territory would identify priority areas for the use of agrolandscapes, determine ways to optimize them and organize sustainable agroecosystems. The finding ways to rationalize land use should be based on an agrolandscape map reflecting the specialization and technology of agricultural production in connection with the differentiation of the natural conditions of the region.

ASSESSMENT OF THE WATER REGULATORY ROLE OF FORESTS (ON THE EXAMPLE OF THE IYA RIVER POOL)

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The drainage basin of the Iya River is located on the territory of the Tulun and Nizhne-Udinsky districts of the Irkutsk region. In June and July 2019, there was an extremely heavy rainfall, which led to the formation of one of the most catastrophic floods in the region since the beginning of the 20th century. The Tulundistricts was particularly affected.

During the first two decades of June, the amount of precipitation already reached the monthly norm (Ikey weather station) or was higher (147% of the monthly norm at Tulun weather station). This contributed to the significant accumulation of stocks of water in the channel network of the river basin Iya. For June 24-28, 2019 at the Tulun and Ikey weather stations, precipitation totaled from 155% to 370%, respectively, and for July 24-29 – from 143% to 106% of the monthly norm. Climate variability of precipitation at the Tulun weather station was manifested in exceeding the maximum monthly precipitation in June and the maximum daily precipitation in June and July according to observations for the time period 1891-1965.

An important water protection and water regulatory role is played by forest cover. The water-regulating role of forests, which is understood as the effect on the distribution of total runoff on surface, subsoil, and groundwater, is manifested through many interrelated characteristics of forest stands.

To assess the water-regulating role of forests, statistical data were collected on the characteristics of the stands, on phenomena that negatively change the state of forests and lead to a weakening of their water-regulating function. An expeditionary survey of key areas and a description of vegetation using geobotanical methods was carried out, satellite images of Landsat 7.8 satellites were analyzed. For the work, we used the results of previous studies on the effect of vegetation on runoff characteristics. As a result of the analysis of the state of the vegetation cover, a map was compiled reflecting its natural-anthropogenic transformations.

The main indicators in the assessment were: forest cover, bonitet, fullness, species and age composition of stands. They affect the transpiration, evaporation of moisture from the forest canopy and from the ground cover. One of the methods for determining transpiration of forest stands is based on the mass of foliage (needles): $E_{tr} = k_{tr} \times m$, (1), where E_{tr} is the transpiration of water by forest stand, mm; m – mass of foliage (needles) in fresh form, t / ha; k_{tr}– coefficient of transpiration activity, equal respectively for pine, spruce and birch 19, 8,5 and 35 mm / t.

It has been established that the forests of the Iya River catchment basin have satisfactory qualitative characteristics in terms of their performance of water-regulating functions. Forest stands of both coniferous and small-leaved species with high values of bonitet and fullness, middle age, are recognized as the best for these purposes. Forests are characterized by a low disturbance of felling, fires, and other disturbances in the mountainous part of the basin and a high disturbance in the plain. In the flat part of the basin, forests are represented by small-leaved stands in combination with small areas of pine forests. The transpiration activity of these forests is high, but its total effect is less than the dark coniferous forests of the mountainous part due to the smaller forest area in the territory.

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LARCH FORESTS OF THE BAIKAL-DZHUGDZHUR TUPE UNDER THE INFLUENCE OF FIRES AND CLIMATE WARMING

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Landscapes of the Baikal-Dzhugdzhur type prevail on the territory of the TRANS-Baikal territory. This type of landscape is associated with the spread of different types of permafrost and seasonally frozen soils, which led to the dominance of the predominantly larch forests of Gmelin larch *Larix gmelinii* (Rupr.) The second most common landscape-forming type of vegetation after larch forests is the yerniki with *Betula fruticosa* Pallas.s.l.

The increase in average annual temperatures since 1990 by 0.4°C, and since 2000 by 0.2°C and droughts lasting more than 10 years have increased the fire hazard of mountain taiga forests.

In the period from 2003 to the 2018 field season, ground-based studies were conducted to assess the condition of larch trees after fires over the past twenty years in the basins of mountain rivers in the South of the Vitim plateau. Trial areas were laid in various forest-growing conditions in larch forests, passed by fires and in long-term not the burning plantations. To assess post-fire changes, materials from the forest management Department of 1996 were used.

It was revealed that for the period from 1997 to 2015, the average frequency of repeated fires in the study area was from three years to one year. Fires of the last twenty years have been characterized by a stable form and high intensity and the degree of damage to stands has increased. At the present time, the drop-off from the stock of stands of ripe larch trees after the impact of strong grass-roots fires is from 40 to 100 %, depending on the type of forest. The increase in the degree of damage to stands by fires is probably due to changes in climatic conditions and increased droughts, and, consequently, better drying of the ground cover, its stronger burning (often to the mineral layer of the soil) and damage to the root surfaces in larch. Significant areas of larch forests were covered by fires and 20-year period, the area forests passed by the fire increased by 43-48%. Area of larch forest lingonberry and rhododendron types of stands reduced with a significant increase in the proportion of grass forest types.

Sustainable and strong repeated ground fires cause the dynamics of species biodiversity. Assessment of biodiversity dynamics based on geobotanical analysis descriptions on 97 test areas, showed a decrease in the number of vegetation species forest groups in the burning areas. There is a significant increase in the number of species of plants of steppes, meadow group. Area shrubs with *Betula fruticosa* increased by 10-17%. In disturbed areas, the degree of coverage of grass and shrub cover is from 60 to 100%. Restoration of 70% of the area of larch trees after strong top and repeated fires is difficult and occurs due to the change of rocks or their transformation into herbaceous and shrub communities.

In General, it is established that in the last twenty years, against the background of climate warming repeated forest fires are the main factor determining the dynamics structures and biodiversity of Baikal-Dzhugdzhur mountain-taiga larch geosystems – indigenous and typical for the territory of the TRANS-Baikal territory.

TRANSFORMATION AND ECOLOGICAL STABILITY OF SOILS OF PHOSPHORITIC LANDSCAPE-GEOCHEMICAL SYSTEMS OF LAKE KHOVSGOL DEPRESSION OF THE BAIKAL RIFT ZONE

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The stability of the soil system is determined by identifying of dynamic changes relative to its qualitatively unchanged state or its ability to resist changes within the limits of natural variability, recover and return to the original "normal" functioning, i.e. of it ability to self-regulate through buffering (internal factor) and the ability to "dump" loads on other ecosystems of Catena (external factor).

The stability of the soils of the studied natural territorial systems is most influenced by such external factors as mountain topography, which determines the position at landscape and the steepness of the slope, climate, which determines the energy of radial geomatic processes (radiation balance, degree of moisture, wind regime) and tectonic processes, which determine lateral geomatic flows (the intensity and direction of seismicity movements).

Internal factors that determine the environmental stability of the studied soils are the humus content, mineralogical, chemical and granulometric composition of soils and soil-forming rocks. The integral stability of soils and landscapes is evaluated through an expert point system for each component of ecosystem, which allows it to be successfully used in practical usage.

A comprehensive study of the ecological, morphogenetic and physical-chemical features of soils associated with the daily surface of phosphorites of the Ongolignur Deposit of Khovsgol phosphorite-bearing basin of Mongolia of Baikal rift zone (BRZ) allowed us to assess the potential environmental stability of different types of soils, developed on phosphate-carbonate rocks of the Deposit, which extends for 50 km within all high-altitude zones of the Khovsgol area (tundra, forest, and steppe). This makes it possible to analyze the possibility of phosphating of water environment of lake Khovsgol in case of industrial disintegration of phosphate rocks during the mining of deposits.

During the process of cryohydration weathering of phosphate-containing soil-forming rocks of the South-Western territories of the depression of lake Khovsgol, as the carbonate component decomposes and is removed, the fine-sanded and coarse-dust silicate material accumulates with a residual accumulation of clay minerals (hydro-micaceous-chlorite-illite composition) and silty organic matter. At the same time, phosphorus and carbonates play a stabilizing role, contributing to the formation of strong carbonate-phosphorus-humus coagulated complexes and, thus, to the accumulation of humus at soils.

The most resistant to the influence of anthropogenic and technogenic factors at the study area of the territory of distribution of phosphorite Deposit are dark gray metamorphic eluviated residual-carbonate soils; humus soils and dark humus clay-illuviated residual-carbonate soils; dark humus-gley soils and cryogenic-micellar chernozems.

In the natural state of the studied mountain landscapes of Khovsgol depression at the outputs of phosphorite' rocks of the Deposits on daily surface and at existence of a strong lateral flow of substances, the conditions for growth of areas of distribution of phosphate dispersions have not been identified, that is due to the development of a carbonate geochemical barrier around the studied geosystems, represented by products of transformation of dolomites and limestones.

In the case of possible mining of phosphorites Deposits, common in the South-Western part of the Khovsgol area, the situation of occurrence of an environmentally dangerous natural and geochemical field is created, that can lead to significant changes at the elemental composition of the natural environment components of nearby territories.

THE FIR-SPRUCE FORESTS OF THE PRIMORSKY TERRITORY (ECOLOGY, GEOGRAPHY)

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The fir-spruce forests of Primorye, being part of the formation of the dark-coniferous forests of the Far East, is form a high-altitude belt, drawn along the slopes and watershed of the Sihote-Alin ridge. The Sihote-Alin mountain country is characterized by complex the geological history, variety of the types of relief, soils and the climatic conditions. The fir-spruce forests formed by *Picea ajanensis* Lindl. et (Gord.) and *Abies nephrolepis* Trautv. (Maxim.), are the main the forest raw base of Primorsky Territory and the most widespread the coniferous formation. There are *Pinus koraiensis, Picea koraiensis, Larix dahurica, L. gmelinii* and other the species. The acreage – 3 million 121 thousand hectares. Wood reserves – 530 million m^3. The prevailing bonality of the forest stand – IV. Tree stands have a high age and almost everywhere the forest stands is dry out.

The group of authors of the Pacific Institute of Geography of the Russian Academy of Sciences are formed the Database (DB) "Forest Vegetation of the Primorsky Territory. Fir-spruce forests". The material was collected on the basis of regular spatial the grids, which are successfully used in ecological and biological the research (Mayorova, Petropavlovsky, 2018).

The Database is consists of 1385 platform-points (5 x 5 km), is tied to the terrain. In order to collect information were used the plans of the forests and the materials of the forest valuation of all forest farms and reserves of the Primorsky Territory. Additionally, information was collected from geomorphological, soil, agroclimatic and other maps of nature (scale 1:500000). There are 23 groups of forest types and types, combined in 4 geomorphological complexes of the coniferous vegetation: subalpine the fir-spruce forests, mid-mountain predsubalpine the fir-spruce forests, the fir-spruce forests of the mountain slopes and fir-spruce forests of valleys, the plumes and unrouted the slopes (Mayorova, 2012). Additionally, in this formation are separated transitional groups of forest types: the spruce-larch forests and the spruce-cedar forests. On the basis of the database a map-diagram is drawn. Their occurrence, association with the types of relief is determined. The fir-spruce forests of mountain slopes have maximum of the distribution, occupying almost 62% the acreage of this formation.

The ecologo-geographical analysis of fir-spruce forests of Primorsky Territory are revealed the most significant the environmental factors (9 factors), determining their structure. Methods of information statistics have been used to assess the impact of environmental factors on the forest (Puzachenko, Moshkin, 1969; Petropavlovsky, 2012; Semkin, 2019). The quantitative connections of the forest communities with the environmental factors have been determined, environmental passports have been drawn up (at the level of species, community). Optimums of their growth in the territory of the region have been noted (Mayorova, Petropavlovsky, 2018). The information are received by us on climatic types of habitats, soil-plant complexes (Mayorova, 2008), the geoecological aspects of the natural stability of the fir-spruce forests (Mayorova, 2012) is determines the optimal conditions of their growth and the potential productivity of trees. The cartographic binding to the terrain of the various taxons of vegetation and their the states (forest types, geomorphological complexes, age stages of forest development, wood reserves, forest areas with mass the drying) will allow significantly clarify the typology and geography of fir-spruce forests, their resource potential, optimize sustainable forest management and protection of forests in the Far East and identify a wide range of the environmental measures.

ON THE ROLE OF CLOUDINESS IN CLIMATIC CHANGES

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The current state of the Earth's climate system is defined as global warming, explained not only by anthropogenic impact (IPCC, 2013). The article is intended to examine the role of cloudiness in climatic changes. According to the literature, it can be concluded that over the past hundred years, the number of clouds on the globe has increased by 1.5 points, which is consistent with an increase in air temperature (Sherstyukov, 2011; Morozova, 2017).

Cloud radiation processes are very complex. On the one hand, clouds keep thermal radiation near the Earth's surface; on the other hand, they reflect most of the solar radiation. In this case, the effect of cloudiness on the thermal regime of the atmosphere varies greatly in warm and cold times. In the warm part of the year (day), the temperature regime of the atmosphere is formed mainly by the incoming short-wave radiation. Cloudiness covers the lower atmosphere from incoming radiation, air temperature decreases. In the cold part of the year (day), the temperature regime of the atmosphere is regulated mainly by changing the flow of outgoing long-wave radiation of the earth and the lower atmosphere, preventing cooling.

Most of the cloudiness estimates are derived from observational data in the afternoon. However, night cloudiness is also involved in radiation-thermal processes. Cloudy fields that form over an area at night decrease effective nighttime radiation. This publication discusses the change in day and night cloudiness. The data on the number of clouds at the weather station Saratov Southeast from 1937 to 2010 were used. The total night cloudiness was estimated from observations at 00.00 UT, the total day cloudiness – from observations at 12.00 UT.

It is found out that over the entire considered period no significant trends in the change in the total cloudiness were observed. Its number remains stable and is 6.2 points. However, if we consider separately the amount of day and night cloudiness, we can conclude that with an unchanged amount of total cloudiness, a decrease in day cloudiness and an increase in the number of total cloudiness points at night are noticeable. Moreover, night cloudiness increases faster than day cloudiness decreases. Thus, against the background of an increase in temperature and an invariable amount of the total cloudiness, an increase in the number of clouds at night is clearly visible. An increase in night cloudiness prevents radiation cooling, contributing to an increase in night temperatures and a decrease in the amplitude of the diurnal variation in air temperature. It is difficult to unambiguously assess the tendency to decrease in day cloudiness, since in the summertime cloudiness prevents radiation heating (negative radiation exposure), and in winter it prevents radiation cooling (positive radiation exposure). However, both the positive and negative radiation effects of day cloudiness also smooth out the amplitude of the diurnal variation of air temperature.

Analysis of changes in total cloudiness and temperature by the method of integral-difference curves showed that from the late 30s to the mid-50s (completion of the second wave of global warming), the consistency in cloudiness and temperature was pronounced. From the mid-60s to the mid-80s (stabilization period), there is a strong discrepancy in the variation of temperature and cloudiness. Further, with the second wave of global warming, the mismatch during these two meteorological variables disappears. Thus, the radiation-thermal effects of cloudiness are different not only in the warm and cold season (days), but also in different periods of climatic variability.

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ROLE OF THE WINTER ASIAN ANTICYCLONE IN THE DYNAMICS OF RELATED CIRCULATION STRUCTURES

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Sustainable socio-economic development of the regions is dependent on the state of the environment. The most important characteristic of the environment is climatic conditions. Across the globe, including in the Asian region, fairly strong changes in the climatic regime have been recorded. According to the Second Assessment Report, the average depth of seasonal thawing is increasing by 1-2 cm in Western Siberia in Yakutia. At the same time, strong intra-annual variability of air temperature and precipitation was observed (Second Assessment Report…, 2014).

The main role in the variability of the weather and climate regime belongs to atmospheric circulation. The weather-determining pressure formation in the cold season in northeastern Asia is the winter Asian anticyclone. In this paper, we intend to consider the dynamics of the Asian winter anticyclone at different periods of climatic variability, which were identified and statistically substantiated in (Morozova et al, 2018).

The stabilization period (from 1950 to 1974) and the second wave of global warming (from 1975 to 2010) were considered as climatic periods. From an analysis of the dynamics of the Siberian pressure maximum in these two periods, we can conclude the following. The latitude of the center of the Asian winter anticyclone from the stabilization period to the second wave of global warming has not changed. However, the longitude of the location of its center has changed. From the first to the second period, its center advanced westward with a simultaneous strengthening of the anticyclone. The strengthening of the Asian winter anticyclone can be explained by a decrease in the area occupied by it, and a significant western shift indicates a weakening of its influence in the 80s - 90s of the XX century in the north-east of Russia, which was emphasized in the publication (Morozova, 2011, Morozova, Alimpieva, 2018).

In addition to the internal dynamics of the anticyclone, its effect on the adjacent circulation structures was studied. Two North Atlantic centers of atmospheric action (Icelandic cyclone and Azores pressure maximum) and two North Pacific centers (Aleutian pressure minimum and Hawaiian anticyclone) were selected as such structures. To study the degree of coupling of these circulation structures on the same diagram, the monthly average pressure change at the centers of these pressure formations is considered. An interesting conclusion can be drawn from the analysis of the diagram. In the months of the warm half year, pressure changes in the two North Atlantic centers of atmospheric action occur in concert. In the cold season, when a winter Asian anticyclone forms over vast expanses of Asia, the consistency (synchronism) in pressure changes disappears. A similar phenomenon is found in the North Pacific centers of action.

The degree of influence of the Siberian maximum on related circulation structures was estimated by the method of variance analysis. A comparison of the total, factorial, and residual dispersions showed that the variability in the course of the pressure difference in the North Atlantic centers of action by 23% is determined by the Asian winter anticyclone. The degree of influence of the Siberian maximum on the North Pacific circulation system is estimated at 16%.

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TRANSFORMATION OF GEOSYSTEMS OF REGIONS AT THE JUNCTION OF THE BAIKAL RIFT ZONE AND THE SIBERIAN PLATFORM

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Addressing the issues of assessing and predicting environmental changes in regions is the basis of modern geographical research. It is based on identifying the direction of geosystem transformation developing under climatic and geodynamic changes. The generally accepted view is, that within the platforms, climate change and vegetation cover during the Cenozoic era were more significant than relief transformations. In this regard, climatic and geobotanical factors are leading in identifying the features of the transformation of geosystems. But research based on these factors is controversial, i.e. it is necessary to study the transformation of geosystem platforms located near centers of tectonic activity.

The study of the transformation of geosystems is of particular relevance for the Lena-Angara plateau region. It is widely viewed that its formation is the result of the influence of the Baikal Rift Zone (BRZ) on the outskirts of the Siberian Platform. Within the Lena-Angara plateau, previously mainly local or small-scale paleogeographic, neotectonic, geomorphological, geobotanical, and landscape studies were carried out. At the same time, the issue of influence of neotectonic processes on the transformation of geosystems received little attention.

In the Late Cenozoic, during the formation of modern geosystems, tectonic transformations occurred simultaneously with climatic changes and caused resonance phenomena and the transformation of geosystems.

Holocene. This is the era of formation of modern geosystems. The Holocene was marked by the activation of tectonic processes. In the South of the territory dominated by pine-birch grass forests with fragments of steppes. Steppes spread to the North of the territory, which is associated with the deepening of river valleys and the formation of terraces. In the North of the plateau, a high-altitude belt is formed, loaches are formed and the area of cedar forests is expanding. In the conditions of barrier shade the area of larch-taiga forests is expanding. Modern landscape boundaries largely coincide with the blocks of the earth's crust and the direction of the main faults

Currently, due to the development of the Baikal rift and the strengthening of the climate continentality, the process of differentiation of geosystems is undergoing further development: the replacement of dark coniferous-taiga types with light coniferous in the southern and western regions, the shift of Siberian stone pine’s stands to higher orographic levels, and the further development of subgoletzgeosystems.

Thus, the spatiotemporal transformation of the geosystems of the research area is largely determined by the location at the junction of the Baikal rift zone and the Siberian platform. The northeastern part of the Lena-Angara plateau from the Pliocene experiences a significant uplift, which occurs simultaneously with the formation of the ridges bordering Lake Baikal. The faults formed in the ancient crystalline basement of the platform, recent intensive elevations of the territory determined the boundaries and modern transformations of geosystems.

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EROSION-ACCUMULATIVE PROCESSES IN THE RIVER VALUES OF THE UPPER PRIANGARIE REGION (THE RESULT OF CATASTROPHIC FLOODS OF 2019 ON THE RIVERS OF THE IRKUTSK REGION)

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The article considers the features of the development of erosion-accumulative processes during the passage of catastrophic floods in 2019 on the rivers of the Irkutsk region of the Angara river basin. The typification of channels and floodplain-river complexes of the studied rivers was carried out. A high geomorphological diversity of channel types within the study area was noted. Based on a combination of morphodynamic river channel types, the main types, the degree of interaction of flood waters and floodplain-river complexes in various areas have been previously determined. The river valleys of the foothill territories are characterized by broad-floodplain branched-meandering with adapted and free bends of the channel with a combination of hollow-island and segment floodplains.

Within the same massifs, significant coastal retreat rates and sections of extreme manifestations of fluvial relief formation can be noted, which are largely associated with disturbance of the natural surface by engineering structures. According to field observations that were carried out during the final stage of the first wave of the flood in 2019, retreat due to the destruction of the coast in the foothills of the Belaya river basin reached 2 m. Such processes were most developed in the ledges of high and low floodplains, composed of sandy-loam deposits on pebbled bases.

Often, river bank destruction was also observed due to slope processes - creeping of the sod horizon along the pebble base. The stability characteristics of the pebble stratum due to water saturation of the aggregate decreases, which activates the processes of its shedding and sliding.

During the passage of floods, waterlogging occurs, flooding of negative forms of floodplain relief, water saturation of soils, which provokes the activation of exogenous geological processes. It is noted that the most intensive transformations of the floodplain-riverbed relief are associated with engineering and construction structures that impede the natural exchange of floodplain and riverbed flows.

The types of exogenous geomorphological processes that have arisen or are activated by the passage of the flood are determined.

In addition to applied ideas about the spectra of processes, mechanisms, and scenarios of the rates of their manifestation within a certain morphodynamic type of a site, the studies performed allow us to solve inverse problems at the regional level: to extrapolate to similar river sections.

In addition, monitoring studies and urgent geomorphological observations make it possible to solve the fundamental problem of the dynamics and direction of erosion-accumulative processes not only within fluvial systems at its various topological levels, but also beyond.

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CHANNEL MORPHODINAMICS OF THE SELENGA RIVER

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The paper presents the results of the analysis of channel morphodynamics of the river. Selenga over a 100-year period. For this, a comparative analysis of the morphodynamic parameters of the channel at the confluence section of the p. Chikoy from the canal Khurul-Khunduy (Paddy Black Golgoi) to the settlement of Novoselenginsk. For three time slices: 1914, 1987, and 2019. measurements were made of the main morphometric parameters: length (l), pitch (L), deflection arrow (h), channel width (bp), as well as coefficients: degree of development of the bend (l/L), ratio of length to arrow of deflection (l/h)

To assess the dynamics of the channel using geoinformation mapping, the contours of the channel were obtained for different time slices – 1914, 1987 and 2019. The main changes over a century-long period were manifested in the form of changes in the elements, types and shapes of bends, dynamics of the width and number of arms, as well as in the processes of dying and the emergence of a new duct.

At the site of the study, the Selenga riverbed adapted with a one-sided floodplain. The channel, shifted to the right (southeast) side of the valley, is characterized by the development of adapted bends of various types, channel and floodplain branching. The root sides of the valley are composed mainly of volcanic formations of the Permian-Triassic age. The planned channel pattern is complicated by the confluence of the Selenga and Chikoy river. The width of the channel here varies from 130 to 200 m, the width of the floodplain is 2.3–3.5 km with a valley width of 2.5 km to 4 km, and the fall of the channel is 18 cm / km. The floodplains are characterized by the development of the relief of the valley-island and segmented-mane types.

Among the planned channel deformations in this section over a hundred-year period, the following were revealed: the shift of bends downstream in the channel, a change in their types due to evolutionary development, an increase or decrease in the tortuosity of the channel.

Also, for this section, secondary and transverse ducts are characterized by a decrease in meandering, especially in the area of the mouth Chikoy river - the village of Novoselenginsk, where from 1914 to 2019 the number of channels, main branches and islands increased. The number of straightening arms increased to three by 2019, the area of the islands increased by 21% (from 8.6 km2 to 10.9 km2). In the area of the mouth of the Chikoy river – islands Kazachikhin and Perevozniy united, whereas according to the map in 1914 and 1987 years they were separated from each other by wide ducts. The situation is similar with the increase in area near the islands of Takhanovsky and Gustovsky, which, in addition to the flood period, completely become part of the bank. Anabranch Telyachya in 1914 served as a full-fledged sleeve, while connecting to the main channel in two places. After the construction of reclamation canals, by 1987 a decrease in the water content of the ducts was observed. By 2019, the southern part of the duct completely ceased to function and dried out, while the northern part of the duct retained its connection with the main channel.

It was revealed that the most dynamic changes are the section of the channel with floodplain multi-arm mouth of the river. Chikoy - n. Novosyolenginsk. Changes were manifested in the form of dynamics of the shapes of bends, the number of arms, an increase or decrease in the area of islands and floodplains. There was a general decrease in the number of segmented and loop-shaped bends.

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PALEOMEANDERS OF BELAYA RIVER (UPPER ANGARA REGION)

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The article presents data on the existence of fragments of the former river network in the Belaya river valley (basin of the Angara river). Valley of the Belaya river is located within the territory of a complex morphotectonic structure. The modern floodplain-terrace complex of the Belaya river is characterized. In particular, data were obtained on the structure of modern low surfaces (floodplains and low terraces), the heights of their basement and morphology. The structure of a fragment of the paleoruslus p. White, which is currently occupied by the Bulayka River. The structure of the fragment of the ancient channel of Belaya river, which is currently occupied by the Bulaykariver, is described. The estimated fragment of the ancient valley of Belaya river, with a length of 13.6 km, is a macro-bend. The morphometric parameters of the incised meanders of the paleovalley exceed the modern meanders of free meandering by almost in two times, but are close in their morphometric parameters to modern incised meanders. Methods and approaches were used to calculate the velocities of the ancient watercourse based on the morphometric parameters of the fragments of the paleovalley; water velocities and flow rates were calculated, which were then compared with the actual values for the Belaya river. The calculated flow and water flow rates of the ancient channel exceed modern parameters by 3,7 and 4,5 times, respectively. However, this parameters close to maximum values during the passage of summer flood. There remains a debatable question about the time of functioning of the river network to which the studied fragment of the paleovalley belonged. At the next stage of research, it is planned to reconstruct the ancient river network of the territory by analyzing basal surface maps. The question of the reliability of the assumption of the existence of the paleovalley is still not completely resolved, because, despite a number of morphological and indirect features, at this stage of the study of the actual data on the presence of alluvial deposits not related to the modern watercourse occupying the valley, it is not enough.

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SYNOPTICAL PROCESSESOVER THE KODAR GLACIER ZONE DURING THE ABLATION PERIOD

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For the first time in July–August 2019, using two automatic stations, the numerous characteristics of the meteorological regime of the Sygyktinsky glacier, central part of the Kodar ridge (south of the Eastern Siberia) were measured. In this work we studied the influence of atmospheric circulation processes in the lower troposphere on the meteorological regime and glacier ablation.

Throughout the observation periodthe Kodar was located on the northeastern periphery of the low pressure area. In the lower and middle troposphere, a positive anomaly of the geopotential height was observed (+25 m for 700 hPa and +35 m for 500 hPa). The center of the anomaly within the Asian continent was located over the Taimyr Peninsula. In low and middle troposphere, a cyclonic field dominated over the study area. At the level of the glacial zone of Kodar (700 hPa), the cyclonic field occurred 65% of the study period, while the anticyclonic only 35%.Under the cyclonic circulation conditions at the 700 hPa level, ascending air movements prevailed in magnitude (on average –0.006 Pa s^{-1} according to the NCEP/NCAR reanalysis data), however, a parity with descending movements was observed by the number of days (anticyclonic circulation 48%).

The predominance of cyclonic circulation over the Kodar resulted to relatively high cloud cover, especially due to the clouds of the middle and lower tiers. According to the Chara weather station, the total cloud cover in July–August over the study period was on average 66% (the lowest value of 41%). The repeatability of clear, semi-clear, and overcast sky for total cloud cover was 6%, 48%, and 45%, respectively, and 29%, 63%, and 8% for the lower clouds. The low cloudiness largely determined the temperature regime on the glacier. Clear sky days (average air temperature 9.8°C) were much warmer than the overcast sky ones (2.8°C).

Time series of air temperature on the glacier demonstrate quasicyclic oscillations, expressed as positive (heat) and negative (cold) anomalies associated with the synoptic changes. These fluctuations were due to the dynamics of atmospheric circulation over the Kodar, or heat (from the west and southwest) and cold (from the north, northeast and west) advections. Positive anomalies were associated with low-gradient cyclonic pressure fields (at the level 700 hPa repeatability 41%), and negative ones with cyclones (44%). Characteristic features of weather conditions during maximum extremes were: low values in cloudiness and relative humidity, and increased values in atmospheric pressure and ice ablation. The duration of heat waves (from 2 to 5 days) was comparable with elementary synoptic periods during which the type of pressure field and the properties of air masses were preserved. The connection between the meteorological regime of the glacier, glaciological changes and atmospheric processes was manifested through weather conditions. Typification of weather in the study area was carried out in this work.

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SPECIFIC HYDROCHEMICAL WATER TYPES

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The name of the hydrochemical water type is given in case when the proportion of the any ion exceeds 20 % of the total equivalent mass (Palmer, 1911; Aliokin, 1953). Ions with such high relative concentrations are called the main and determine the type of water. Ions of bicarbonate (HCO_3^-), sulfate (SO_4^{2-}) and chloride (Cl^-) are usually considered the main in water bodies. These anions form the corresponding classic hydrochemical type. Modern data convincingly confirm that under specific natural or technogenic conditions the anions of hydroxide (OH^-), nitrate (NO_3^-) and fluoride (F^-) also become the main ones.

Hydroxide water is a specific type of anionic water composition that is found in natural and technogenic water bodies. Its occurrence has a local character in springs or aquifers. It is characterized by a strongly alkaline reaction with a pH of more than 11. Hydroxide water is formed in water bodies as a result of dissolution of hydroxide minerals, hydrolysis of aluminosilicates without carbon dioxide, hydration of oxides, hydrolysis of carbonate salts, and dissociation of water molecules. In the majority of cases hydroxide water is non-carbonate and usually is not linked with the carbonate system.

The origin of nitrate water is chiefly due to human activities since hydrolyzable nitrogen has very low environmental concentrations. Nitrate waters arise as a result of the following economic activities.

1. Production of nitrate fertilizers.
2. Nitrate fertilization of soils.
3. Livestock (poultry) waste.
4. Household and municipal sewage.
5. Radiochemical production.
6. The use of ammonia-nitrate explosives.

The formation of natural nitrate water might have been caused by the decomposition of protein residues. Such conditions arise in areas of bird guano accumulation or in areas of thanatocenoses of aquatic organisms.

The ion of fluorine is rarely included in the group of main ions due to its complex migration features. Calcium fluoride is hardly soluble (the solubility of CaF_2 at 20°C is 0.016 $g \cdot L^{-1}$), therefore, the accumulation of fluorine in natural water is limited by the presence of calcium ions. The formation of fluoride water arises only when fluoride ions are continuously get into the water bodies due to the dissolution of minerals or substances containing fluorine. Fluorine rarely dominates among anions, it follows the classical anions.

Highly alkaline sodium and calcium-free water is recognized as extremely favorable for the accumulation of fluorine in natural water bodies. The fluorine content increases with increasing salinity in such water bodies.

Technogenic opportunities for the formation of fluoride waters originate with the production of primary aluminum. Soluble *cryolite* Na_3AlF_6 is used for smelting this metal. A cryolite scrap is contained in slime waste that is hydraulically discharged into the slime fields. The concentration of fluorine in slime water reaches 8 $g \cdot L^{-1}$, therefore, the fluorine share in the slime water reaches 29%.

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RADIOCARBON DATING OF LAKE BOTTOM SEDIMENTS AND RIVER BANK SECTIONS OF THE SELENGA RIVER DELTA

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This paper presents the results of geomorphological studies conducted in the river mouth area (RMA) of the Selenga River for the last 10 years. The RMA covers a wide range of territories from the main bifurcation node of the river channels to the shoreline of Lake Baikal. RMA also includes subaerial and subaqueous parts of the protruding Selenga Delta, the zone of interaction between modern fluvial processes and relic deposits of different-aged terraces, as well as the Proval and Cherkalov bays adjacent to Lake Baikal. Banks of the distributary channel and islands are high in the upstream (around the first bifurcation) and central parts of the delta, and are exposed up to 3 m above the water surface during summer low flow period. Oxbow lakes and relics channel network exist on the islands and high banks, some of which are filled with water. High floodplains (up to 1 m above the water surface) and low seasonal floodplains also exist throughout the delta. Terrace deposits share similar structure and consist alternating channel and floodplain facies, interbedded with paleosoil horizons (from 1 to 3 horizons). At the base of a typical terrace section, there are either coarse-clastic facies of well-rounded alluvium or reddish-brown cemented sediments, which are Neogene in age. Bottom sediments of oxbow lakes are represented by organic sediments (gittia), and up to 3 m in thickness, overlying alluvial sediments. Sediments of Proval and Cherkalov bays are represented by silty sands with peat interlayers or lenses.

Samples for dating were taken from buried soil horizons and interlayers or lenses of peat at the boundaries of lithological facies, from lake cores and floodplain sections. Radiocarbon dating of the samples was carried out at the Köppen laboratory (St. Petersburg State University). Calendar ages are based on the OxCal 4.3 calibration program. Absolute elevations of all sections and cores are measured. For the modern floodplains, a geomorphological comparative analysis between topographic maps from different years and drone surveys was carried out. The analysis made it possible to distinguish three generations of floodplain terraces, formed during different stages of tectonic development of Lake Baikal, as well as areas of shores and islands that are not affected by geomorphologic activities.

Results of the radiocarbon dating indicate that the Selenga RMA has ages ranging from 13200±730 years ago (sandy clay sediments of Lake Baklanye) to 340±110 years ago (paleo-arable horizons on surfaces of high terraces) and 380±50–160±120 years ago (peat layers on the coast of Proval Bay). Sandy clay deposits of Lake Baklanye at the turn of 5250±210–5185±190 years ago are abruptly replaced by organic sediments (gittia), specifically occurring in the closed lakes of the delta, which still exist presently. In the Cherkalov Bay, from 2905±205 to 1765±235 years ago and present, sedimentation and accumulation of silty sands with peat lenses occur. Paleo-soil horizons in the bank sections at the upstream part of the delta appeared between 4210±260 and 3840±450 years ago, and are deformed by permafrost processes. The most frequently appeared ages for marker beds in the delta are: 2150±150, 1960±150, 1940±100, 1150±80, and 1160±120 years ago.

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THE TRANSFORMATION AND THE DYNAMICS OF THE TRANS-BAIKAL TERRITORY LAND RESOURCES

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The land as the most important multi-purpose natural resource acts, in particular, as the main economic resource, the territorial basis for planning of economic activities, and the territory in which the primary environment-forming benefits are being developed.

The area of the land fund (LF) of the Trans-Baikal Territory (Russia) is 43 189.2 thousand hectares. The analysis of the condition and use of land resources revealed the territorial peculiarities of the land use structure, several trends, and some negative processes evident in the current practice of regional land use. Significant predominance of forest land is observed in the structure of the regional LF. No essential shifts in the distribution of forest land between land users have occurred since 2000.

Agricultural lands are especially valuable for the development of the agro-industrial complex of the region and for provision of its food security. The total area of agricultural lands is 7 645.6 thousand ha, or 17.7 % of the LF total area territory. The structure of agricultural land reflects the livestock specialization of agricultural sector. The dynamics of the areas shows that over the past decades the share of arable land in the agricultural land has been constantly decreasing.

Natural and climatic conditions exacerbate the anthropogenic transformation of the natural environment. According to the estimates of the Directorate of the Federal Service for State Registration, Cadastre and Cartography for the Trans-Baikal Territory, there are 1,500 thousand hectares of eroded land in the region, 439.3 thousand hectares of which are subject to erosion, 521.7 thousand hectares – to deflation, and 454.1 thousand hectares are simultaneously affected by two erosive processes. In general, over 10 % of farmland in the region is mainly affected by water erosion. The processes of water erosion develop most intensively on arable land: up to 78 % of the arable land in the region is subject to water erosion. This is largely due to the predominance of various steepness slopes in the relief.

A terrain analysis of the region performed by the authors on the basis of SRTM data (digital elevation model) using the functionality of the ArcGIS Spatial Analyst extension, allowed us to evaluate some of its characteristics that have a significant impact on the state of the land and its susceptibility to erosion processes. According to our estimates, about 65 % of the Trans-Baikal Territory are elevated areas (above 800 m above sea level), and 67 % of the territory are slope areas. At the same time, slopes of up to 4° are peculiar both for the bottoms of depressions, the valleys of watercourses, and the peaks of the watersheds. And thus, the most of the territory can be referred to the category of areas with conditions provoking the development of erosion processes.

Moreover, the results of the analysis showed spatial heterogeneity in the distribution of slope landscapes in the context of municipal entities of the Trans-Baikal Territory. The share of slope areas is from 43 to 82 % of their areas. The smallest areas of slope landscapes are in the Ononsky (18 %) and the Duldurginsky (36 %) districts. But in the Krasnochikoysky district they occupy 82 % of its territory, in the Petrovsk-Zabaykalsky district – 75.7 %, and in the Chitinsky district – 51.5 %.

Thus, the analysis of land resources of the Trans-Baikal Territory performed with the use of GIS technologies, allowed us to classify municipalities according to the environmental and economic balance, to identify the peculiarities of the regional structure of land use over time and to display them on the maps.

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COMPENSATORY TRANSPLANTATION (RHODODENDRON AURUM GEORGI) AS AN ELEMENT OF CONSERVATION (RESTORATION) OF ECOSYSTEMS OF THE NORTH

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The implementation of large-scale industrial projects in the mining industry is accompanied by negative consequences, inter alia for rare species as the most sensitive element of ecosystems.

The first stage of construction of the Udokan mining and processing complex (MPC) with the annual capacity of 12.0 million tons of ore is intended for the extraction and processing of ore from the Udokan copper deposit (the Trans-Baikal Territory) (https://www.bgk-udokan.ru).

As a result of engineering and environmental survey, the areas of growth of golden rhododendron (*Rhododendron aureum* Georgi), an evergreen shrub included in the Red Book of the Trans-Baikal Territory, were identified at the site where facilities of Udokan MPC will be located. In addition to the Trans-Baikal territory in Russia, the species was taken under protection in the Kemerovo region.

This type of protected plant is widely distributed within the Kodar-Udokan mountain region; it participates in the composition of the shrub layer in the most of the forest-growing formations, successfully recovers and adapts in case of sudden changes of the environmental situation. The specificity of habitats and their proximity to the upper mountain belts are the limiting factors for its distribution.

Environmental measures to preserve the species were provided for in the design documentation for Udokan MPC construction.

In 2019 INREC SB RAS specialists developed the basic principles of compensatory measures for the preservation of golden rhododendron during the implementation of this project.

In the studied plant communities 27 model sites (S = 2500 m^2) were laid on the sites allocated for the placement of Udokan MPC facilities. At the sites the structure of vegetation was studied, and the nature of the relief was described, as well as exposition and steepness of slopes, moisture conditions, and soil type, i.e. the complex characteristics of growth of rhododendron. The quantity of specimens of golden rhododendron was registered by standard methods for assessment of the stock of economically valuable plants (Methods of Study, 2002). As a result of the research, the possibilities and limitations for translocation and rehabilitation activities for this species have been established, and sites for digging and planting have been proposed. The trial diggings were made. The technology of digging and planting of this species has been developed.

In August of 2019 320 specimens of golden rhododendron were dug at one of the selected sites. On the prepared site outside of the zone of destruction by Udokan MPC facilities, specimens of the protected plant were transplanted. In September an inventory of planted specimens was carried out and their condition was assessed. According to the preliminary estimates, the survival rate was 98 %, which is higher than the average.

It is planned to continue work in this area.

The results of this survey and the recommendations of this article can be used in preparation measures and reclamation at the deposit (after completion of its development) as an element of work to restore natural ecosystems.

CLIMATE, NATURAL ENVIRONMENT AND THELIFE SUPPORT SYSTEM OF THE TUNGUS: CULTURAL AND ECOLOGICAL ASPECTS

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The life support system of the Tungus (Evenks) is closely connected with and dependent on both natural and sociocultural environments. Climate changes are regarded as a major factor affecting landscape and Indigenous peoples (Crate, Nuttall, 2016; Lavrillier, 2013; Indigenous Peoples…, 2019). Natural climate variability have a long history and cyclical character. The periods of relative stability alternate with variability and fluctuations of temperature conditions, humidification, and increased frequency of natural disasters. The purpose of this work is to compare the available data on the natural environment changes and the economy of the Tungus people within a period of more than a hundred years in order to better understand their cultural dynamic and strategies of adaptations.

The research area includes the Cis-Baikal region, where at the time of the arrival of Russians, groups of Tungus lived. The primary landscape was a source of their economic, cultural and spiritual well-being. These communities lived in the forest-steppe, taiga, and mountain-taiga bioregions .They interacted with the settled Russian and semi-nomadic Buryat populations. A variety of geographical conditions, diversity of neighboring cultures facilitated the formation of the local economies, and influenced the speed, depth and intensity of cultural contacts.

The study of socio-environmental history of non-literate peoples is complicated by the lack of sources. This fully applies to the Tungus who lived near lake Baikal, the upper Lena and Kirenga rivers, and lower Ilim river. Information about their numbers, economy and lifestyle of the late XVIII-early XX centuries represented in the reports of governing bodies called *inorodnye upravy*. These data reflect mile stones in the transformation of Tungus society and the multicultural environment of the region. They are however fragmentary and do not provide the opportunity to build continuous series of observations. We have used the data of the Irkutsk chronicles of P.I. Pezhemsky and V.A. Krotov (1911) along with the Irkutsk chronicles of N.S. Romanov (1914) in order to reconstruct the climate trends before regular meteorological observations began. Information includes the freezing-up of the rivers and abnormal climatic phenomena, as well as reports on Baikal lake water level (Modern geodynamics..., 2003).

The analyses show that apart from the powerful factors of socio-cultural and economic communication and involvement in the state economy, the dynamic of natural environment plays a significant role in the formation of adaptive strategies of the Tungus. Their joint effect contributed to the formation of patterns of territorial habitation; some of the Tungus became settled and significantly russified, others remained nomadic; a multicultural environment emerged. A network of unique fluid environmental management practices and a system of interconnections had been developed. Local groups of Tungus in the era described by our research possessed adaptive potential. They were able to integrate natural and social fluctuations, successfully transforming them into a state of "sustainable survival."

EVALUATION OF CHANGES TO THE LANDSCAPE STRUCTURE OF THE CATCHMENT AREA OF THE GOLOUSTNAYA RIVER BASED ON ANALYSIS OF MATERIALS OF RSE

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The hydrological regime of all water bodies is in connection with the components of the landscape within which it is formed.

Today, the landscapes of many territories are subject to change, under the influence of anthropogenic pressure. These changes are especially noticeable during the development of mountainous areas, where the connections of landscape components can be easily transformed.

To assess changes in the landscape structure, detailed materials and maps of river catchments are required. This problem can most successfully be solved solely on the basis of landscape studies in the river basin and using the landscape map of this basin.

Assessment of changes in the landscape structure of the Goloustnaya river catchment was carried out using materials "Landscapes of the South of Eastern Siberia", data on global changes in forest cover in the 21st century (High-Resolution Global Maps of 21st-Century Forest Cover Change), obtained on based on Landsat satellite imagery with a spatial resolution of 30 m and reflecting the actual change (since 2000) in forested areas. This will make it possible to trace dynamic changes in the structure of landscapes, caused by both natural and anthropogenic factors (deforestation, forest fires, plowing, etc.).

Deforestation, grazing, haying, plowing, road holding, settlements, etc. change the nature of the flow from the pool.

Therefore, when conducting landscape research, it is necessary to distinguish between territories that retained properties and territories that modified. In general, we can say that due to human intervention, the nature of the flow from the river basin not only changes significantly, but also becomes more complicated.

Thus, the undisturbed areas of each landscape were calculated and information on transformed lands was obtained.

In accordance with the landscape map of Mikheev, Ryashin, the catchment of the Goloustnaya River (2280.6 km^2) includes the territory of 9 landscapes. Using the QGIS software package, information was obtained on the area of each landscape, as well as the area of plots with a changed landscape structure, in accordance with the gradation of the time series, divided into equal segments, at 5-year intervals (2001-2005, 2006-2011, etc.)

The total area of territories with a disturbed landscape structure, from 2001 to 2018, is 447,1 km^2 (19.6% of the catchment area).

To a large extent, the landscapes "taiga" and "mountain taiga, dark coniferous" were transformed, areas with a changed structure within the landscape amounted to 81.5 km^2 (51.4%), 97.3 km^2 (54.3%), respectively. Within the study area, the above landscapes occupy – 159 km^2 (7%) and 180 km^2 (8%) of the area, respectively.

The next most converted lands are the mountain taiga pine landscapes – 460 km^2 (20% of the catchment area of the Goloustnaya river). Territories with a changed landscape structure are 85,4 km^2 (19%).

A significant part of the catchment area – 971.4 km^2 (43%) is occupied by "mountain taiga, dark coniferous" territories, however, changes in the landscape structure are insignificant and amount to 119 km^2 (12.2%).

Knowing how the catchment area of the Goloustnaya river changed in a quantitative aspect, at the next stages of the study it will be possible to obtain information about qualitative changes in the landscape and their effect on runoff.

FEATURES OF THE MANGANESE CONTENT IN NATURAL WATERS OF THE JEWISH AUTONOMOUS REGION

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The Jewish Autonomous Region is a biogeochemical province, deficient in I, F, Ca, Mg, Cu, Se and excess in Fe and Mn. The excess of these elements is most pronounced in natural surface and groundwaters (Bolotova, 2003; Bondareva, 2009; Khristoforova et al., 2012; Surits et al., 2014). In the surface waters of the region, the iron content was mainly studied. The manganese content remains poorly studied. At the same time, studies of the Mn content in the surface waters of the EAO are becoming increasingly relevant. The region has begun the development and mining of iron-manganese ores in the north-west of the region in the Bijan deposit. However, we are not sufficiently aware of the forms of migration of this element, their change, and the possible negative impact on aquatic organisms.

Water samples were taken in July 2019 mainly on the left tributaries of the Bolshaya Bira River (Jewish..., 1999), which lies between the mountain systems of the Small Khingan and the Bureya Range in the north of the region (Atlas..., 2007). The valley of another large river Sutara, flowing into Biru, is located between two ranges – Small Khingan and Sutarsky. In the upper reaches of Bira (in the basins of the Kuldur and Sutara rivers), numerous manifestations of ferromanganese ores are noted.

Determination of the total content (of all forms) of manganese in water was carried out on a Kvant-2 AT atomic absorption spectrometer in accordance with PND F 14.1: 2: 4.214-06. Samples were taken in accordance with GOST Z 51592-2000 at 11 stations in the estuary or estuary zones of the Bira tributaries. In the rivers draining territories in the zone of the Bijan deposit (Sutara, Kimkan, Kuldur, Birakan), the Mn content was 0.036–0.042 mg / dm^3. The concentration of the element decreased markedly (0.004–0.018 mg/dm^3) in river waters with a shift of sampling points to the east. In the rivers of the Bureinsky ridge, manifestations of manganese ore content are no longer felt. The lowest element content is defined in p. Nikita – 0.004 mg/dm^3.

The highest manganese content (0.139 mg/dm^3) was found on the southernmost of the sampling points located in the lower reaches of the Ikura River, 8 km from the confluence with the Bira River. There is also the least transparency and the highest color of water.

The normal maximum permissible concentration (MPC) of manganese for fresh water is 0.01 mg / dm3 (MPC-2010) and is more stringent than 0.1 mg/dm^3 for iron. This is due to the high redox potential of Mn and the associated avoidance of its excess by aquatic animals (Karpevich and Shurin, 1977). For the river waters of the Amur basin (Levshina, 2012), the suspended form of manganese reaches 94.5% of the total dissolved and suspended forms, in the rivers of the world it is even higher - up to 98.3% (Gordeev, Lisitsyn, 1978). Mn, which binds to the organic complex, with an increase in the humus content in water, passes into the dissolved form mainly in wetlands. This changes his migratory abilities, turns water into high-color. Mn is becoming more accessible and more dangerous for the aquatic population.

NATURAL AND HUMAN DRIVERS OF ISLAND GEOSYSTEM TRANSFORMATION (PRIMORSKY KRAI)

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Island geosystems are extremely dynamic and changing systems due to interaction between the land and the sea. Both natural and human-induced processes cause changes in island landscapes and their components. Due to regional differences in physical and biotic conditions, as well as land use intensity, the relationships between natural and human-induced drivers in landscape changes show variability from site to site. Knowledge of the relationships between dynamic natural processes and the impact of human activities provides the basis for land management recommendations and development of conservation strategies.

The main objective of this paper is to analyze the relationships of natural and human-induced processes on island geosystems of Primorsky krai with emphasis on species diversity of vascular plants and lichens as well as landscape diversity and soil condition.

Islands of Primorsky Krai lie in the southern part of the Russian Far East. More than 40 islands of variable size host unique ecotone communities maintaining high biodiversity. Permanent settlements exist on the largest islands (Russky, Putyatina, Popova, Reyneke), while the rest are involved in some degree of economic activity (tourism, aquaculture, etc.). Several islands are a part of the Far Eastern marine biosphere state nature reserve.

Land area of the study islands is covered with broad-leaved and coniferous-broad-leaved forests. In human-transformed areas, the native landscapes have been replaced by oak forests without shrub layer and by communities of *Lespedeza bicolor*, *Artemisia gmelinii, Miscanthus sinensis*. Several islands maintain great populations of endangered species: *Taxus cuspidata*, *Nelumbo komarovii*, *Kalopanax septemlobus*, *Lilium cernuum*. Lichen species diversity on islands depends on suitable habitat availability, distance from the mainland and human impact degree. Islands with low human impact maintain lichen communities containing rare species.

Dominant oak forests of the islands are mainly formed on highly skeletal typical burosems with general traces of firedamage. Burozems with a shallow and less developed soil profile are found in the upper parts of steep slopes and along narrow slope ridges. Dark burosems with a highly and deeply humificated soil profile dominate under high-closed broad-leaved forests with dense herb layer. Dark illuvial-humic burosems are formed under herb-bush-subbush communities under active geochemical sea influence. Soils of forests with coniferous tree species are shallow podzolised burosems. Landscapes of gentle slopes and mid-steep slopes prevail on the largest islands. They are composed of granite and granitoid. The islands are bounded by landscapes of abrasion-denudation cliffs with gravel-pebble sediments with supralittoral and petrophyte vegetation.

Economic activity on the largest islands resulted in simplified landscapes which become obvious if we compare Putyatina isl. and Popova isl. Previously, there was industrial activity on Putyatina isl.; its impact resulted in changes of the landscapes. In spite of a smaller area of current human influence, there are changes in landscape structure, high fragmentation and decrease in biodiversity per area unit. The small islands with less anthropogenic influence have more species diversity of vascular plants and lichens, including rare species per area unit. Small islands are of minor interest in terms of economic activity and have natural protection against anthropogenic influence (inaccessibility), therefore they are “hot spots” of biodiversity. The largest islands subjected to human activity have lower species diversity. Most part of the islands is an erosion vulnerable area. Sheet erosion is a serious problem along roads in human affected areas.

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MANAGEMENT CYCLE IN THE FIELD OF FOOD SECURITY IN THE TERRITORY

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The relevance of these studies is due to the insufficiently developed mechanism for managing food processes in the area of ensuring food security in the territory, which significantly reduces the efficiency of their regulation and, in turn, leads to the irrational use of resources (natural, labor, etc.) and the emergence of negative consequences and threats. Thus, to ensure food security, as a process that directly affects the socio-economic conditions of society, it is necessary to create a management mechanism adequate to the conditions of a market economy, one of the important aspects of which, of course, is the constant analysis and evaluation of the current and forecasted state of the food system. At the same time, actions to justify the trajectory of the food system development and actions aimed at maintaining its characteristics on a given trajectory contain a management cycle.

This study is devoted specifically to the development of the management cycle in the field of food security. The need for its development is predetermined by the lack of a conceptual concept of ensuring food security at any of the territorial levels. The practical significance of this cycle lies in the possibility of conducting timely qualitative and quantitative accounting of all types of agricultural raw materials and food, identifying emerging threats in this area, assessing the current and forecasted state of the food system taking into account current trends, as well as information and analytical support for the development and implementation of measures to ensure accessibility for the whole population of quality food. Qualitative and quantitative accounting and state assessment involves the use of methods of economic analysis, an integrated assessment of the level of food security using generally accepted criteria and indicators, as well as strategic planning methods.

The proposed cycle synthesizes the main elements of the management system: planning, organization, coordination of management mechanisms and control of situations prevailing in the field of food security, as well as the management object, referred to as a managed system that sets the initial data for monitoring and evaluates the result. The management cycle creates the prerequisites for conducting system monitoring, developing management decisions to enhance food security resulting from the iterative food process, to determine the current situation in ensuring food security and possible coordination of actions in this area.

Thus, an attempt is made to develop a mechanism for providing the authorities and management with complete, objective and reliable information about the current state and development trends of the food system in order to make an effective management decision to strengthen it.

FEATURES OF CADASTRAL ASSESSMENT OF AGRICULTURAL LAND OF AGROLANDSCAPES OF IRKUTSK REGION

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In the modern conditions of Russia's transition to a market economy, the state cadastral assessment of land resources, and first of all, - of agricultural land, becomes a necessary element for justifying of land tax, rent and other payments in transactions with land plots.

According to its natural features, the Irkutsk region is divided into three agricultural zones: steppe, forest-steppe, and forest (taiga-subtaiga) zones. More than 50% of the total area of arable land in the region is located at forest-steppe landscapes, 20% - is located at the steppe, and the rest falls on taiga landscapes.

Agricultural lands of the Irkutsk region should be evaluated according to the accepted rules of state cadastral assessment (SCA).

Guidelines recommend to conduct of state cadastral assessment of agricultural land on the basis of the Unified state register of soil resources (2014), on the calculation of standard yield and technological (standard) costs.

It should be noted that there is no experience of practical use of the new guidelines in the Irkutsk region. By calculating of the specific indicators of cadastral value (SICV) of different types of soils, and knowing the area that is covered by these soils, it is possible to calculate their cadastral value for specific cadastral plots. It should be noted that such information is not available in modern cadastral materials.

According to the Handbook of agro-climatic zoning, the Irkutsk region is divided into 4 agro-climatic subzones.

In the first agro-climatic sub-zone, crops are not grown, due to low values of agro-climatic indicators. Agricultural land is used here mainly for hay and pastures. These territories (Katangsky, Bodaybinsky, Mamsko-Chuysky, Kazachinsko-Lensky municipal districts) are characterized by low cadastral value indicators. The lowest values (0,1-0,3 RUB/m^2) were observed for sod-podzolic and sod-alluvial layered soils. In sod-carbonate soils, the values of the specific indicator of cadastral value (SICV) range from 2.5 to 2.7 RUB/m^2. The highest values of SICV were recorded at alluvial sod saturated and alluvial meadow saturated soils (3.3-3.0 RUB/m^2).

In the second agro-climatic sub-zone the maximum values of the standard yield have been recorded at podzolic chernozem and at meadow-chernozem' soil. For the same soils, the maximum SICV (2.8 -3.4 RUB/m^2) were also noted. Despite the relatively high values of humus content and humus horizon capacity, the soils of the second zone are characterized by low values of SICV, that do not exceed to 3.5 RUB/m^2. This is due to low values of the agro-climatic potential, which ranges from 3.3 to 3.6.

In the third agro-climatic sub-zone there is a decrease in value of SICV of ordinary chernozems due to their salinity of about 60%.

Thus, the cadastral value of agricultural land in the Irkutsk region demonstrate the sensitivity of the method to the soil and geographical conditions of the region. Low values of cadastral value of land are due to low indicators of agro-climatic potential. The obtained materials allow us to use the data of cadastral land assessment to optimize land use, planning land management activities and to develop strategies for sustainable land management of the Baikal region at a whole.

LANDSCAPE-HYDROCHEMICAL ASPECTS OF GEO-ECOLOGICAL MONITORING

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A methodology for integrated geo-ecological monitoring has been developed, which is based on the principle of mixing. Identification of sources of contamination and observation of connections between them and environment objects is carried out by consideration of man-made substance of objects as mixtures, and substances of sources as their components. Observation of linkages involves the establishment of pathways and methods for the migration of a substance from the source to the receptor, as well as the determination of the relationship between the amounts of the substance of the sources in the receptor. The environment change is predicted by determining changes in the ratio between the source proportions in the receptor and the ratio of the contributions of the source substance to the receptor. This approach should provide a joint assessment of the extent of geosystems contamination, identification of sources and routes of entry of pollutants into Lake Baikal and the geosystems components of its catchment basin. The main instruments of research are methods of landscape science and hydrochemystry.

The mapping framework is necessary to justify the network of observations and monitoring, extrapolate monitoring results in territories not captured by direct observations, display operational information on the state of geosystems and ecosystems. A set of cartographic support methods for monitoring the pollution structure and distribution of pollutants in the Lake Baikal basin has been defined. The mapping technique is based on the positions of V.B. Sochava's doctrine on geosystems. The tools for identifying the structure of economic activity are the methods of landscape-geochemical synthesis, mapping of agrarian landscapes, landscape planning and retrospective cartographic analysis of geosystems with a long history of economic development. The determination of the pollution structure of Lake Baikal, its tributaries and catchment in general is carried out by analyzing the spatial and temporal distribution of pollutants in environmental components. Mapping of pollutant differentiation is carried out using modern methods of geo-information analysis and modelling adapted to the basin of Lake Baikal.

The main parameters of landscape-geochemical differentiation of Lake Baikal basin are analyzed. A scheme of regionalization of the territory according to the ability to provide a certain composition of waters has been developed. The study obtained a picture of the spatial distribution of the ability of Lake Baikal Basin aquatic and terrestrial ecosystems to self-cleaning from from organic substances, including organic pollutants. General indicators of water composition for Baikal and its tributaries have been developed, linking their pollution to catchment conditions. According to the data on the content of metals in snow cover, the predominant anthropogenic sources of metals have been identified. It has been established that in both natural and anthropogenic modified geosystems the main factor in the formation of water composition is the chemical composition of their geological foundation. In disturbed geosystems, water composition also depends on the intensity of contamination, the specificity of its sources and the ability of water bodies to self-purification. It has also been found that the ability of waters to self-purification from a particular metal depends on its affinity for the organic matter of waters. The ability of surface waters of the Baikal basin to self-purification has been assessed. The contaminant removal rate was calculated as the ratio between the flow rates of contaminants at downstream and upstream measurement stations. The contaminant removal capacity was calculated as changes in the rate of removal of contaminants in the watershed between these stations.

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DYNAMICS OF VEGETATION RECONSTITUTION IN POST-AGRICULTURAL LANDSCAPES AT ENVIRONMENTS CONTACT

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Studies of the peculiarities of vegetation structure on post-agricultural landscapes in central part of the Selenga R. basin (South-Western Trans-Baikal) revealed modern trends of phytocoenoses formation during last decades since the land stopped being used for cereals agriculture and pasturage. We have to state while characterizing the peculiarities of vegetation transformation in the Selenga R. Basin that land use in this region under the conditions of relatively drought periods during different years resulted in evident elevated anthropogenic degradation of soil and vegetation cover. As the Selenga R. Basin is situated within very important biogeographic boundaries, namely within boundaries between regions and provinces of southern boreal forests and zonal dry bunchgrass steppes of Central Asian type, where zonal forest-steppe is formed with its transition into zonal steppe, the processes of environment decay are better expressed. Modern climate dynamics with increase of mean annual temperatures and shifting of main precipitations amount towards late summer and autumn (on the background of climate aridization in the beginning of last century) at decrease of pasturage during last decades result in relative reconstitution (and in numerous cases – further degradation) of the herbage structure. Synfolia differentiation and increase of common projective cover are observed, species diversity of phytocoenoses increases. There are reconstitution processes of forests at the place of steppe territories everywhere, both at tilled lands and at former pasturage sites. Open stands of dry pine forests with cereals and motley grasses form, this is an initial stage of formation of forests of zonal type. It can probably result in changes of forest-steppe boundary in latitudinal direction with further forestation of steppe territories. Vegetation formation at yields and pastures may be constrained by probable increase of anthropogenic impact, mainly due to pasturage accompanied often to periodic fires (burnings). Partially survived field-protective forests are represented by invasive plants of the genus *Populus.* According to the scale of the state categories of these trees (they are of 3rd-5th categories), they are considerably weak up to new deadwood. Supposed cases of drying are: overmature wood of vegetative origin (grafts) and physical-geographic conditions on the territories such as zones of transition of forest-steppe to steppe. Due to this fact, it is necessary to stop further using of steppe and forest-steppe, especially transitional between forest-steppe and steppe territories for agriculture; to use regulated pasturage with temporary exclusion (up to 10–15 years) of these sites from intensive pasturage, as reconstitution potential of vegetation (period of reconstitution successions) is low due to specifics of physical-geographic conditions in the studied areas as well as in the whole region; it is possible to plant artificially seeds of vegetation species ecologically close to local environmental conditions; for territories used for haying (including ploughed up before), i.e., on the sites of riverine terraces above the flood plains with relatively higher humidity for this region, it is recommended to take into account the fruitage periods of major part of vegetation species forming the phytocoenoses as more sustainable ecosystems; it is not recommended to plough up new areas and yields ever more.

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THE DYNAMICS OF THE COENOSTRUCTURE AND EDAPHIC CONDITIONS OF RANGELANDS WITH A CHANGE OF THE REGIME OF THEIR UTILIZATION (WESTERN COAST OF LAKE BAIKAL)

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The vegetation cover of the western coast of Lake Baikal has long been used as rangelands, primary for pasture of sheep and cows. This is especially characteristics for the extrazonal steppe territories of the study region. The steppe here has an azonal character, and, according to a number of typical attributes of the coenostructure, they should be regarded as the stage of space-time dynamics of interrelationship between the light-coniferous taiga and steppe since Holocene time. In this connection, the coenostructure and edaphic conditions of rangelands of this territory are highly different from the other areas of Baikalian Siberia.

The unsystematic character of pasture, combined with the neglect of the peculiar dynamics of coenoses, their species compositions, as well as physical and chemical properties of soils led to a degradation of rangelands, with low productivity and recovery of biocoenoses. Desertification processes and an enhancement of lithomorphicity of steppe geosystems were observed for some areas of the territory. The vegetation of the steppe, largely cryoxerophyte, geosystems of Lake Baikal's western coast is characterized by very low productivity. Excessive numbers of sheep and cows, with the neglect of the pasture capacity and long-term overgrazing, led to the formation of coenoses with very low floral representation, as few as 10-15 plant species. Coenoses often constitute a mosaic of curtains of separate species, mainly consisting of rhizome perennials that form on soils of coarse mechanical composition. The most intense pasture load occurred in the 1960–1990s. The pasture density (numbers of sheep and cow per ha) was 1.4 and 0.7 in the summer and winter seasons (more than 100 sheep and cow per 10 ha), respectively. Since the early 1990s, in connection with a decrease of the numbers of sheep and cow, there has been some stabilization of the phyto-edaphyc environments of the study territory, however, the trend of recovery processes of extrazonal steeps depends largely on the characteristics of dynamics of climate factors, mainly of regional-topological level.

The basis for the grasses of the steep rangelands in the western coast area is formed by representatives of such families as *Poaceae*, *Asteraceae*, *Cyperaceae* and *Fabaceae*. The coenostructure of steep communities is distinguished by a high degree of polydominance, low projective cover, and numerical indices of the species composition by seasons of the growth period. The nabitat conditions of the coenoses are responsible for the specific of their dynamics, functioning and recovery. The steppe geosystems of the western coast area of Lake Baikal are dominated by primitive organogenic-detritus, steppe noncarbonated and chestnut soils, at the contact of steppe and light-coniferous steppesized geosystems there is a wide occurrence of combinations of sod forest steppesized and sod souls. Chernozem-like soils occur sparsely, which often accompany zones of active faults. A very small area is occupied by southern (farinaceous-carbonate) chernozems. In creek valleys and valleys of temporary water courses there occur meadow, meadow-chestnut and sod-meadow gleyed soils. The soils are distinguished by a small thickness of the profile, with typical fine-earth-gravelly-stony composition with the predominance of sandy and coarse-silty fractions and, according, a high degree of mobility of the soil thickness, as well as predominantly funnel water penetrability. With such edaphic conditions, overgrazing over the course of many years initiated degradation processes of the phyto-edaphic environment. To recover the bioproductivity of rangelands will require recalculating the load and establishing different conditions of utilization of biogeocoenoses of the study region at all. The monitoring of the coenoses formation is very useful method for obtaining the information about consisting of the pasture lands.

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EFECT OF FIRE SEVERITY ON LICHEN ASSEMBLAGES IN THE SOUTHERN RUSSIAN FAR EAST

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Fire is a major form of natural disturbance and it shapes the structure, biodiversity and functioning of ecosystems affecting their physical, chemical and biological conditions. Fire has strong impact on lichen communities due to they lack protective tissues, such as cork. Lichen thalli can be completely destroyed by the fire. Other fire disturbances include damage to photosynthetic apparatus and the reproductive structures because of high air temperature during the fire. As a consequence of fire impact, structure, taxonomic and functional diversity of lichen communities change.

In oak forests of the southern Primorsky krai (the south of the Russian Far East), different fire severity resulted in dramatic variation in epiphytic lichen diversity. A total of 193 lichen species belonging to 77 genera, 35 families and 14 orders were found in the study area. Severity and time regime of fire affect vitality and species diversity of the lichen cover. According to the fire regime all study sites were distinguished into four categories. The sites with regular fires have the lowest species diversity, dominance of tolerant and nitrophilous lichens with wide ecological range, as well as decreasing the rare taxon part. Nitrophilous lichens, such as *Candelaria concolor*, *Phaeophyscia hirtuosa, P. rubropulchra* are often found. The lichens are discolored, misshaped and burnt. The tree trunk bottoms have lack of lichens or tiny lichen thalli. Total projective cover of lichens at the height of 0-100 cm is 1-3%, above 100 cm – 10-15%. Lichens grow in the cracks of bark. The sites with often fires, which have traces of old fire events are characterized by species richness of 19 – 29 taxa. Projective cover of lichens at the bottom part of tree trunk is 10%, above the height of 100 cm – 15-20%. Lichens are often discolored and misshaped, but sometimes healthy thalli occur. These sites comprise widespread and nitrophilous lichens, rare species are sparse. The sites with rare fire events have from 30 to 59 lichen species. The projective cover below 100 cm is 40-50%, above 100 cm – 60-70%. Healthy lichen thalli are dominated. The part of widespread and nitrophilous species is decreased and the part of sensitive species to fire impact, such as *Flavoparmelia caperata, Parmelia saxatilis, Menegazzia terebrata,* is increased. Long-unburnt sites maintain healthy species. Lichens grow on the tree trunk from the bottom to the canopy with total cover of 70-100%. High species diversity and many rare lichens are found at the long-unburnt sites. Some of the rare species are included in Red books of Russian Federation and Primorsky krai: *Anzia colpodes, A. opuntiella, A. stenophylla, Cetrelia japonica, Coccocarpia palmicola, Leptogium burnetiae, L. hildenbrandii, Lobaria retigera, Menegazzia terebrata, Myelochroa perisidians, Nephromopsis ornata, N. rugosa, Pannaria lurida, Parmelina quercina, Parmotrema arnoldii, P. cetratum, P. reticulatum, Punctelia rudecta, Pyxine sorediata, U. rubicunda.* Relict and endemic species emphasize lichen cover singularity of long-unburned sites. The ground fires have shaped secondary lichen cover of nitrophilous and fire tolerant species. Lichen cover can indicate the first stage of forest community transformation under fire influence.

GEOGRAPHY AND ECOLOGY OF THE TRUE BUGS (HETEROPTERA) INHABITING JAPANESE ELM IN THE LOWER REACH OF THE SELENGA RIVER

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In the lower reach of the Selenga River (Republic of Buryatia) grows a representative of broad-leaved forests - Japanese elm (*Ulmus japonica* (Rehd.) Sarg.). In Baikal Siberia Japanese elm is a relict species-edificator which forms refugia of nemoral biota. The main areal of the species is in the Far East, China, the Korean Peninsula and Japan. Elm communities are represented in the form of groves or not great forests that can be significantly distanced from each other. These communities are inhabited by relicts characteristic for nemoral forests (plants, lichens, mosses, fungus).

In 2014-2019 fauna of the true bugs (Heteroptera) was studied in elm groves on the Selenga River. Heteroptera – insects with semimetamorphosis which distributed around the world, live in most terrestrial and many aquatic types of biotopes, have different types and breadth of trophic specialization.

In result 16 species of true bugs from 12 genera and 5 families were collected from *U. japonica* trees in the study area. Among them only 7 species were collected only from elm and were not found on the surrounding vegetation. Two species from the family Miridae - *Deraeocoris ater* (Jakovlev, 1889) and *D. olivaceus* (Fabricius, 1777) – are predators, they are not trophically related to Japanese elm, but prefer to settle on this species rather than on other deciduous trees surrounding elm trees groves. *D. ater* is distributed in the south of Siberia and the Far East of Russia, in Northeast China, Korea, and Japan. *D. olivaceus* has a wider trans-Eurasian range. Two species of oligophagous that are trophically associated with deciduous trees, but in the study area were collected only from Japanese elm: *Pilophorus confusus* (Kirschbaum, 1856) (Miridae) and *Pentatoma rufipes* (Linnaeus, 1758) (Pentatomidae). In contrast to the genus *Pentatoma*, which are phytophagous, species of the genus Pilophorus are zoophytophagous. Both species have rather wide ranges, *P. confusus* - European-Siberian, *P. rufipes* - transpalearctic. One species of the family Aradidae - *Aradus hieroglyphicus* J. Sahlberg, 1878, like most flatbugs feeds on fungus and lives under the bark of weakened trees. The species has an East Palaearctic type of range. In the study area, this species inhabits only Japanese elm. Two more species of true bugs of the Miridae are trophically closely related to species of the genus *Ulmus*, these are *Pilophorus mongolicus* Kerzhner, 1984 and *Psallus ulmi* Kerzhner et Josifov, 1966. *P. mongolicus* has a narrower range that encompasses Siberia and Mongolia. This species in the communities of U. japonica is collected in a single copy; *P. mongolicus* much more characteristic for communities of another species of the genus *Ulmus* - *U. pumila*. The most typical species for Japanese elm communities was *Psallus ulmi*, which is collected in large quantities here. This species is common in Eastern Siberia, in the south of the Far East, in China, on the Korean Peninsula.

Thus, the fauna of Japanese elm true bugs in the lower reach of the Selenga River is formed mainly by local, widespread species. The number of species obtained is not large, among them only 4 species prefer this tree as a fodder plant. Relict and Far Eastern Heteroptera have not been discovered here yet. Most of the studied species of true bugs have wide distribution types, but at the same time their ranges cover the Far East, China, Korea, or Japan, with the exception of *P. mongolicus*, whose main range extends to the south. For a better understanding of the formation and functioning of the elm refugia of the Japanese elm in Baikal Siberia, it is necessary to carry out similar studies in the Far East of the Russian Federation, in northern China, as well as in Mongolia, where the Japanese elm can also form refugia.

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EXPERIMENTAL RESEARCHES OF EROSION PROCESSES IN STEPPE LANDSCAPES

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Water and wind soil erosion is one of the most important international problems today, especially in arid regions. The steppe landscapes of Priol'khonie (the central part of the western shore of Lake Baikal, south of Eastern Siberia) were selected as the object of study, where denudation processes are intensively developing. The spread of sheet and linear erosion leads to fragmentation of the landscapes. Experimental observations of the transfer of matter allow us to obtain a quantitative assessment of the values and speed of erosion processes in different conditions and can serve as a justification for the selection of recultivation and environmental measures.

The number of quantitative characteristics of water and wind erosion processes has been obtained during field experimental studies of 2015–2019 in the Priol'khonie steppe landscapes. The study of water erosion was carried out using a portable rainfall simulator that catches transferred silt (Vanteeva&Solodyankina, 2015; Znamenskaya et al., 2018). The study of wind erosion was carried out using a complex of traps (dust collectors), a particle counter (model DT-9880) and a digital hot-wire anemometer (DT-618) to measure wind speed and air temperature at different heights. The amount and characteristics of the transferred silt were determined. Statistical analysis of factors that influence erosion processes was made.

The results of multiple regression analysis showed that the main factors affecting the erosion processes: the quantitative ratio of the fractions of the mechanical composition of the upper soil horizon (most often a positive relationship is expressed with the content of silt and dust) and the steepness of the slope. The negative relationship was revealed with soil rockiness and projective cover of herbaceous vegetation. The soils of Priol'khonie are characterized by an unfavorable structural composition. There is an increase in the number of particles in diameter of less than 0.5 mm, which are most erosion-hazardous. The results of the study showed that the development of denudation processes in the steppe landscapes of the Priol'khonie is primarily due to natural factors and intensifies under the anthropogenic impact.

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NATURAL COMPLEXES AND STRUCTURAL DIVERSITY OF TOFALARIA VEGETATION

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Regional sustainable development is determined by optimizing the natural management and preserving the natural environment in all its variety. The geographical location of Tofalaria in the mountainous part of the Siberian region determines its specific socio-economic situation related to natural conditions. The area is the northern macro-slope of the central part of East Sayan. In general, these are places of traditional natural use and residence of a small indigenous tofalars. Its minor part in the west is occupied by the Tofalar federal reserve, established to preserve particular natural complexes with mountain taiga Siberian stone pine forests and its fauna.

The northern macro-slope of East Sayan – highlands with absolute altitude over 2800 m and aggregate system of predominantly medium-altitude 1500 - 1800 m mountain ranges, dissected by a dense network of deep erosion river valleys. Relief has a complicated tectonic structure and is characterized by intensive neotektonic upwarp-block uplifts of the denudated folds of the Proterozoic and Paleozoic time. During the Quatenary period, the area was repeatedly icing. Perennially frozen grounds are common here. Under the East-Siberian type of ultra-continental climate with increased aridity the distribution of vegetation follows altitudinal climatic zonality, but different relief aspects, steepness and other factors of micro-climatic conditions due to contrast mountain relief, determinate complicated spatial mosaic (pattern) of natural complexes and vegetation cover.

There are goletz, subgoletz, mountain-taiga belts and fragments of forest-steppe. Goletz vegetation is represented by the South Siberian tundra communities. Subgoletz belt is characterized by shrub communities, alpine and rich tall grass subalpine meadows in depressions, and Siberian stone pine and larch sparse woods, too. The upper forest boundary varies between 1700-2100 m. Characteristic for the mountain-taiga area formations of Siberian stone pine, larch, spruce communities occupy about 60 % of the territory. Dark-coniferous Siberian stone pine rhododendron subshrub-true mosses, fir-Siberian stone pine and spruce-Siberian stone pine bilberry-small grass-true mosses forests are concentrated on leveled surfaces and gentle slopes. Siberian stone pine, larch-Siberian stone pine Ledum-mosses on shady and gentle slopes. Spruce and larch-spruce shrub-forb forests are timed to the sloped areas and bottoms of wide river valleys, which are also characterized by yernik overgrowth (Betula fruticosa). Light-coniferous larch shrub-moss (Drepanocladus uncinatum) forests occupy vast areas, rising through the river valleys to subgoletz belt.

Pattern of natural complexes played a significant role in the formation of the high- and middle-altitude mountain flora of the South Siberian physical geographical oblast, caused with the knotty position in the mountain system of Prebaikalie and Mongolia. There are isolated natural complexes with relic plants locations particular to the western outskirts of Central Asia and Altai. Montana and mountain-steppe, forest, meadow-forest plant species have both Mongolian-Siberian and wide circumpolar areal of northern Eurasia. Genetic diversity of vegetation cover is supported by a complicated mosaic of natural complexes that have formed and persisted under modern conditions.

ESTIMATION OF THE QUALITY OF GROUNDWATER IN THE SETTLEMENTS OF ANGARA REGION

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Groundwater is the most exploited and demanded fresh water resources used for household and drinking needs. The lack of quality water is a big problem in many regions of the world (Shweta 2013, Wazir A 2020). The purpose of this study is to assess the quality of groundwater in settlements located on the coast of the upper part of the Bratsk reservoir, for the suitability of their use for household and drinking purposes. Groundwater was taken from 20 wells and one draw-well for drinking and household water supply. In the samples, the concentrations of the main anions and cations, iron, manganese, fluorine, nitrate ion, the value of mineralization and pH of the waters were measured.

In hydrogeological terms, the study area is part of the Angara-Lena artesian basin. The basin of the Bratsk Reservoir is characterized by a variety of groundwater in terms of occurrence conditions, which varies in area and depends on the composition of the host rocks, feeding conditions, and the intensity of water exchange (Ovchinnikov 1999). Within the territory, there are several aquifers: groundwater of Quaternary sediments, fractured-stratal waters associated with rocks of the Jurassic, Silurian, Ordovician and Cambrian ages and water of fissure-karst type in gypsum and carbonate rocks of the Cambrian.

In the studied settlements, groundwaters with different hydrogeochemical types were identified: hydrocarbonate-sulphate (Seredkina village, Kazachye village, Balagansk village, Zalari village, Krasnoe Pole village, Tyret village, Svirsk village, Kamenka village, Pozdeeva), sulfate (Tashlykovavillage,Molkavillage, Novo-Leninovillage,Kamenno-Angarskvillage,Bokhanvillage), chloride (Khadahanvillage), hydrocarbonate (Apkhaitavillage, Sanatorium, Angarskyvillage, Olonkivillage, Osa village, Kutulik village), the cation composition is also diverse – Mg-Ca, Na-Ca, Ca, Mg-Na-Ca. Prevailingwaters are HCO3-SO4-Mg-Ca and SO4-Mg-Ca. The greatest variations are subject to concentrations: Cl- (from 1 to 3900 mg/l), Na + (from 3 to 2150 mg/l), SO42- (from 20 to 1500 mg/l), Ca2 + (from 23 to 700 mg/l) l), NO3- (from 0.05 to 76 mg/l), Mn (from 0.01 to 0.29 mg/l) and Fe (0.0002 to 0.1637 mg/l). Differences between the minimum and maximum concentrations of HCO3- (from 78 to 535 mg/l), Mg2 + (from 5.3 to 159 mg/l), K + (from 0.8 to 10 mg/l) and F- (from 0,2 to 2.1) are less significant. The mineralization value varies from 141 to 8600 mg/l. The waters are neutral with a pH from 7.1 to 7.8.

The water quality index (WQI) is used to assess the suitability of groundwater, which is calculated as the sum of the actual values of the considered indicators compared with the world Health Organization standards for drinking water (WHO 2011). Water quality status is classified as unacceptable (WQI> 300), very poor (200 <WQI <300), poor (100 <WQI <200), good (50 <WQI <100) and excellent (WQI <50) (Batabyaland and Chakraborty 2015).According to the results of the research, the spatial variability of groundwater quality was revealed, which mainly depends on the depth of the aquifer. It was found that in the majority of samples the quality of groundwater in the study area is classified as excellent or good. An exception is the underground waters of the village of Novo-Leninoi, village Hadahan, in which the quality of water for drinking purposes is classified as poor and unacceptable, respectively. Such unfavorable indicators are associated with increased concentrations of SO42-, Cl- and high mineralization.

DIFFERENTIATION OF THERMO-FREEZING REGIME OF SOILS IN THE SOUTHERN TRANSBAIKALIA

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Intensive utilization of natural resources in the southern Transbaikalia caused a substantial environmental modification. In this region, agricultural activity main lyproceeds within slopes of the river's valleys (frequently, these are the trough-valley natural systems), plain steppe, veld-forests and so on. We estimated the soils' thermal resources using the published data of Transbaikalia Administration on hydrometeorology. Measurements of soil temperature usually refer to forest-free regions within populated localities. Therefore, so-obtained thermal characteristics of soils can be used as the reference points for estimating the extend of human activity (deforesting) influence on the environment.

Broad variations in the soil temperature are characteristic of the southern Transbaikalia. The soil temperature varies in the ranges of-2.5 ÷ -19, -0.5 ÷ -12.5 and 2.8 ÷ -3.2ºC at the depths of 0.2, 0.8 and 3.2 m respectively. The mass of data is classified in four groups that are characterized as moderately cold, cold, very cold and severe based on qualitative characteristics of their thermal conditions.

The moderately cold soil conditions refer to the temperatures of -2.4÷-6.1, -0.6÷-2.2 and 2.8÷1.5ºC at the depths of 0.2, 0.8 and 3.2 m respectively. They are characteristic of the Lake Baikal eastern coast and of the valley of the Selenga river inflow, where gardening is possible. The seasonal freezing of soils extends here to 0.8-1.6 m and it is not durable. Moderate wintery cooling of soil define the special climatic conditions of the Lake Baikal coast, which are characterized by sums of the mean diurnal air temperatures below -10 ºC(Σt for< -10ºC) from -1345 to -2005ºC and by the highest wintery snow coverage (H) in the range of 20-40 cm.

Under the cold conditions, soils possess temperature in the ranges of -11.5 ÷ -13.2, -5.7 ÷ -8.2 and 0.5 ÷ -2ºC at the depths of 0.2, 0.8 and 3.2 m respectively. This type of soil is distributed over all the territory considered and it is typical of slopes of the through-type river valleys as well as of the plain steppe and veld-forest. This is the main type of soils for agricultural exploitation. Seasonal freezing of these soils starts in November and it exceeds 3.2 m almost everywhere. Permafrost can be present at moderate depths in the temperature measurement locations. The values of Σt for < -10ºC from -2165 to -3540ºC and H from 5 to 15 cm correspond to the cold sol conditions.

A special depth profile of temperature is characteristic of the very cold conditions of soils. In the upper layer (0.2 m), it is in the range of -15÷-19ºC (up to -21.5ºC in exceptional cases). The temperature increases steeply with depth and reaches 1 ÷ -2ºC at 3.2 m. Seasonal freezing of the upper layer starts in November. Its maximum ep this about 2.4-3.2 m. The very cold soils have the values of Σt for < -10ºC from -2080 to -3625ºC and H from 5 to 20 cm. This type of soils prevails in the southern Transbaikalia where it is evenly distributed.

The severe conditions of soils are sporadic in the territory considered. They were noticed in the southern and south-eastern regions. The temperature varies in the ranges of -14 ÷ -16 (0.2 m), -9 ÷ -12.5 (0.8 m) and -2 ÷ -3.2ºCat the 3.2 m depth. These conditions are associated with Σt for < -10ºC from -2406 to -3825ºC and shallow snow coverage.

The results of this study of spatial distribution of the soil temperature in the southern Transbaikalia reflect certain geographical tendencies, which – when expressed in a cartographic form – facilitate solving the formulated problem.

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NEW DATA ON THE DISTRIBUTION OF THE BASIC PHILOGENETIC LINES OF THE KOREAN FIELD MOUSE *APODEMUS PENINSULAE* IN THE FAR EAST OF RUSSIA

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The Korean field mouse *Apodemuspeninsulae* Thomas, 1906, being a background species of mixed and broad-leaved forests of the Eastern Palearctic, can be a model object for researching changes occurring in forest ecosystems since the Quaternary period. Isolated and insular populations are of particular interest for researching the history of the species, because each such population has evolved independently. In previous molecular genetic researching (Serizawa et al. 2002, Sakka et al. 2010), it was shown that all individuals of the Northern range of *A. peninsulae* belong to two phylogenetic lines "Primorye" and "Korea". Also, several specimens were analyzed, which were small in number and the regions of Northern and Western Transbaikalia are not covered. That is clearly not enough for such a vast and geographically complex territory. We tried to fill this gap in this article, which aims to identify the phylogenetic structure of the Korean mouse *Apodemuspeninsulae* in the North of the range.

In total, 42 samples of Korean mouse tissue were used, captured in four local populations of Transbaikalia and five populations of the South of the Far East: Buryatia, Oshurkovo (n=10), Buryatia, Taksimo (n=4), Buryatia, Barguzin (n=1), Zabaikalsky Krai, Cheremushki (n=1), Amur Region, Bomnak (n=1), Khabarovsk Krai, Chegdomyn (n=4), Khabarovsk Krai, Polina Osipenko (n=4), Sakhalin Region, the mouth of the Langrariver (n=9), Primorsky Krai, Stenina island (n=8). To construct phylogenetic reconstructions, an incomplete section of the cytochrome *b* gene of mitochondral DNA with a length of 992-bp was used. The obtained sequences were compared with homologous sections from GenBank/NCBI.

The analysis of the Korean mouse cytochrome *b* sequences obtained in this work revealed 26 haplotypes, of which 23 were described for the first time, and 20 were unique. Taking into account the previously described sequences, but excluding the South China line described earlier from the analysis (Sakka et al., 2010), the number of haplotypes was 110, polymorphic sites – 127. According to the results, all the individuals of *A. peninsulae* researched by us are assigned to two phylogenetic lines "Korea" and "Amur", which are consistent with the lines "Korea" and "Primorye" of other authors. The differences between these lines are marked by 7 nucleotide substitutions, the distance between them is 0.0185±0.0031. Previously, there was increased genetic diversity in samples from Siberia and Mongolia (Serizawa et al., 2002; Bayarlkhagva et al., 2013). At the same time, it was suggested that there were refugiums in these areas during the Quaternary ice age, where the ancient genetic diversity of the species was preserved. Our data support the hypothesis of increasing diversity due to the contact of two differentiated phylogenetic lines "Amur "and "Korea". It is suggested that the formation of the "Amur" phylogroup occurred in the middle and/or lower Amur Region. It is shown that individuals with the haplotype "Korea" penetrate not only the southern Altai and Eastern Transbaikalia, but also occur in the Northern regions of Transbaikalia and in the vicinity of Chegdomyn (Khabarovsk Krai). The similarity of haplotypes of the sample Taksimo (Buryatia) and Chegdomyn (Khabarovsk Krai) suggests the possibility of settling *A. peninsulae* from West to East and back along the Baikal–Amur Mainline, along the railway track.

COAL-FIRED POWER PLANTAND WATER ECOSYSTEMS

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Water ecosystems are the most vulnerable element of the environment that react to any changes within its catchment area. An example of the influence caused by coal-fired power industry on water ecosystems is the natural and man-made complex "Lake Kenon – TPP-1". Lake Kenon is a natural freshwater lake of the Amur river basin that lies in the limits of the city of Chita, Russia, (52°02′19″ N 113°22′50″ E), at an altitude of 653 m above sea level. The catchment basin area of the lake is 227 km^2, the surface area is 16 km^2, the average depth is 4.4 m, the largest depth is 5.2 m, the length is 5.7 km, the average width is 2.8 km, and the shoreline length is 17.4 km (Ekologia…, 1998). In 1965, a regional hydroelectric power plant was built on the shore of the lake; it was further transformed into a thermal power plant No. 1 that employs brown coal of the local deposits. Lake Kenon, in this complex, is used by the plant as a cooling pond, which affects the thermal regime of the lake and contaminates it with chemical pollutants. Another impact of the coal-fired power industry is the ash wastes coming through water streams and collected in ponds located within the catchment area. The ash disposal pond of the TPP-1 was constructed without a liner and located 3 km (1.9 miles) northwest of the lake. The average seepage rate is 550 m^3/hr. The seepage from the ash disposal pond contributed to hydrocarbonate and sulphate composition of the surface and bottom layers of the area up to the lake with mineralization of 1.0 g/L and total hardness to 16-17 mg-equ/L. (Usmanov, Usmanova, 2010).

At the same time, Lake Kenon is an inner-city lake affected by man's activities and railway and road traffic lying within its catchment area. Besides, it is used for recreation and fishery.

The observations cover the profile of heavy metals in the ash pond of TTP-1 and the flow direction of the seepage. Chemicals enter the lake with the operational wastes of TTP-1, the seepage, and with the flow of the Kadalinka River. These flows influence macro- and microcomponent composition of the water of Lake Kenon and accumulate in its hydrobionts (Bazarova, 2014; Kuklin, 2014; Tsybekmitova et al, 2017).

Consequently, coal-fired power industry has a negative effect on the environment due to the technology of incomplete combustion of coal.

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THE MAIN FEATURES OF SOCIOCULTURAL TRANSFORMATIONS IN THE LANDSCAPE OF THE BARGUZIN CISBAIKAL REGION

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Over the past three centuries, the factor of ethnic identity and interethnic interactions has played a significant role in the transformation and development of Russian society. The vast territory by tsarist Russia, and later the USSR, was distinguished by ethnic, confessional, linguistic, anthropological, and, as a result, cultural heterogeneity. A territorial reflection of cultural diversity is a complex set of ethnocultural landscapes generated by the interaction of ethnic communities with each other and with their environment.

The study area is located between the high and inaccessible Barguzinsky ridge, crowned by rocky peaks of loaches (up to 3000 m high) and the Ikatsky ridge, which borders the Barguzinsky valley from the north-east. Its ridges are wide, flat watershed spaces with gentle flattened peaks. The climate of the Barguzin Valley as a whole is characterized by sharp continentality with comparative severity and aridity. More severe climate conditions have mountainous areas of the Barguzinsky and Ikatsky ranges and the upper reaches of the Barguzin River. The average annual temperature in the basin is 2-3 degrees Celsius, and in the mountainous regions minus 5-7. Long (more than 6 months) winter is characterized by severe frosts, dryness, clear skies and calm.

The approach of ethnocultural landscape science allows us to distinguish the traditional (maximum development of ethnocultural traits), transformed traditional (allochthonous borrowings and adaptation of traditional culture to the changed social and natural environment), modern (collectivization and settlement, intensive forced transformation of lifestyle, globalization) stages of development. The ethno-cultural landscape, as a natural-geographical and ethnic construct, forms the basis of the socio-cultural, spiritual and economic ties of the community in dynamics.

Socio-natural patterns were revealed: the growth of resettlement systems is interconnected with the formation of sacred objects networks, and the achievement of natural and ethnocultural boundaries, together with the transition to more advanced environmental management models and a social structure, stabilizes the pattern of territory development. The main factors determining the formation of a specific pattern of settlement within the ethnocultural landscape of the territory include: the lack of continuous, suitable for agricultural development potential arable land; the orographic structure of the territory; microclimatic restrictions on agricultural activities; the contrast of natural landscapes, allowing a wider range of uses, compared with the historical homeland of immigrants; a different rhythm of natural processes, setting a different nature of the life-support cycle; the absence of serfdom both in Siberia in general and in the Barguzin Cisbaikal region in particular; lack of ownership of land and the intricacies of land relations between the Buryat and Evenk clans; economic traditions of each ethnic group in the region.

As a result of the combined impact of these factors, a settlement system is emerging in the Barguzin Valley, the main feature of which is the combination of “niches” (cattle-breeding, agricultural, hunting), characteristic of the economic and cultural type of each ethnic group, with “hybrid” areas of nature management, images and traditions. The borrowing of techniques and methods of farming, fishing, cattle breeding and hunting, expressed not only in space, but also in temporal aspects. The mosaic of ethnocultural landscapes prevailing in the study area is the result of a number of political and socio-geographical processes. The violent transformation of the Soviet period, the preceding exile and spontaneous ethnic migrations led to the formation of flexible ethnic communities that are configured to interact with both the changing natural and social environment.

LANDSCAPES OF THE IYA RIVER BASIN

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The landscape analysis of the Iya river basin was made in order to identify the landscape-hydrological conditions of the flood formation in 2019. There were only small-scale landscape maps for the study area, their detail was not sufficient to solve the task. That is why, a landscape map of the Iya River basin was composed at a scale of 1: 500 000. The territory under consideration is heterogeneous in terms of physical-geographical conditions: features of the relief, moisture. So, different landscapes and different types of intra-landscape differentiation were formed here. Electronic multi-scale topographic maps, Landsat 7 and 8 satellite images, digital elevation model, slope steepness and exposure maps, small-scale landscape, geobotanical and soil maps were used to make a landscape map of the Iya River basin at a scale of 1: 500 000. The classification of landscapes developed for the map "Landscapes of the South of Eastern Siberia" (Mikheev, Ryashin, 1977) is taken as a basis.

Alpinotype and tundra landscapes predominate in the upper part of the middle-mountains (more than 1000 m): mainly rocky and rockfall-talus slopes with sparse vegetation cover, goletz planate surfaces lichen, talus slopes with lichen cover. They are combined with surface wash slope sparse wood larch with mixed under growth lichen and slope larch with cedar and mixed undergrowth of limited development. Mountain taiga dark coniferous landscapes of limited development are dominated in the lower part of the middle mountains (800-1000 m):by the area - slope fir-siberian stone pine bilberry-grass-true mosses with bergenia in some places, slope siberian stone pine with spruce and larch subshrub-true moss; by the frequency –subgoletz shrub and sparse wood landscapes: of configured surfaces and gentle slopes yernik-lichen, of gravity drift slopes mountain pine shrub-alder with larch sparse wood, slope siberian stone pine alder-yernik moss-lichen.

There are foothill and intermountain depressions taiga, foothill subtaiga, southern taiga uplands and plains, subtaiga landscapes in the foothill-plain part of the basin (600-800 m). The gradual transition from the mountainous to the flat part of the basin is carried out through landscapes of foothill plains fir-siberian stone pine subshrub-short grass-true moss, morainic and foothill high plains siberian stone pine with spruce and larch cowberry-true moss.

The submontain part of the basin is characterized by the predominance of landscapes of inland bog deltas with shrub-sedge-moss cover in combination with sedge meadows and pine forests. They are combined with landscapes of plain and depression bottom spine cowberry-forb with shrub undergrowth.

Southern taiga dark coniferous landscapes of uplands prevail on the high plains in the northern part of the basin: slope siberian stone pine-fir sometimes with larch short grass-true moss. They are combined with submountain and on high plains and plateaus subtaiga landscapes - plain and the bottoms of depressions pine cowberry-forb with shrub undergrowth and flat surfaces pine grass.

The landscapes of the mountainous, foothill-plain and upland-plain parts of the Iya River basin differ significantly in their appearance, components characteristics, and the nature of their functioning. There are alpine, subalpine, mountain taiga, taiga, subtaiga landscapes. The area of landscape units increases from southwest to northeast as the altitude and vertical dissection of the relief decrease; their diversity increases towards the foothill part of the Iya river basin.

TRANSFORMATION OF THE PRAIRE-STEPPE PINY WOOD FLORA OF THE SOUTH-EASTERN TRANS-BAIKAL

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Tsasucheisky piny wood is located at the South-Eastern Trans-Baikal near the boundary with Mongolia. This territory is included in the State Nature Reserve of Federal Importance "Tsasucheisky Piny Wood". Air temperature rise and low amount of precipitation resulted in fire hazard growth (Golyatina, Vahnina, Noskova, 2018) and catastrophic fires which nearly destroyed the Tsasucheisky piny wood.

During the research of the Landsat images for the period from 1986 to 2018 in ArcGIS-10 software the analysis of the wooded area of piny wood was performed. Use of the satellite images of the spectroradiometer Terra/MODIS allowed to determine areas covered by fires (product MCD45A1), and vegetation indexes NDVI и EVI (product MOD13A) for the Tsasucheisky piny wood territory. The analysis of the climate factors impact (such as air temperature, amount of precipitation, humidity factor) on flora is performed according to the data of 4 meteorological stations of the Trans-Baikal Department for hydrometeorology and environmental monitoring (Aksha, Borzya, Nizhny Tsasuchey and Solovyovsk), located near the research territory.

The results of the research showed that the fires are the key factor of flora transformation at the territory of Tsasuchey piny wood, and its recovering is closely connected with humidifying of the territory. During the last drought period (from 1999 to 2012) piny wood area was reduced from 43.5 to 2.5 thousand ha as the result of the catastrophic fires in 2000 (28.1 thousand ha), in 2003 (19.7 thousand ha), in 2012 (20.2 thousand ha). Correlation coefficients between investigated vegetation indexes on the territory of Tsasucheisky piny wood and meteorological factors show the proved connection with amount of precipitation and hydrothermal index (humidity factor), herewith, the EVI shows higher correlation coefficients with meteorological parameters than NDVI, which indicates its high informative value. The greatest direct connection between medium and maximum values of EVI index and precipitation amount ($r = 0.76$) is revealed. At the average, in the dynamic of EVI annual average minimum values the positive trend is observed which shows the increase of the flora on the territory of Tsasucheisky piny wood in the warm period of research.

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DIAL GROWTH OF PINE IN THE TAIGA AND STEPPE ZONES OF TRANSBAIKALIA AS A REFLECTION OF THE CLIMATIC PARAMETERS AND DYNAMICS OF THE LAKES HYDROLOGICAL REGIME

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The results of the annual rings width research of the trunk test core sampled from growing common pine are received. The purpose of the research is the analysis of the ability to use the radial recruitment changes of the trees growing in different natural zones for further reconstruction and prognosis of the climatic variables and lake hydrological regime.

It was revealed that the dynamics of annual rings width in the steppe zone is characterized by the maximum values of the standard deviation and sensitivity to environmental factors in comparison with taiga zone trees.

The correlation parameter between pine annual rings width changes of the Bauntovskaya Cavity (taiga zone) and meteorological data showed that the radial recruitment has a positive response on July air temperature. The dynamics of the radial recruitment of the Tsasuchey Pinewood (steppe zone) has a positive response on June and July precipitation and negative response on air temperature of the same months.

The analysis of the synchronicity of Tsasuchey pinewood trees recruitment changes with interannual water-level fluctuation of the Barun-Torey Lake due to the climatic conditions dynamics showed the significant correlation, herewith the maximum correlation with lake reaction lag for 4-5 years occurs. Any significant correlations with water level of the Baunt lake in taiga zone (the Bauntovskaya Cavity) are absent.

Consequently, the tree-ring chronology based on pines of steppe zone can be used for retrodiction of the hydrometeorologic elements, while the radial recruitment changes of the taiga zone showed no hydroclimatic factors except positive response on July air temperature.

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CURRENT DYNAMICS OF AEOLIAN PROCESSES IN THE MOUNTAIN-BASIN RELIEF OF RUSSIA AND MONGOLIA (LAKE BAIKAL BASIN)

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The work is dedicated to deals with the study of the modern dynamics of aeolian processes within the mountain-basin relief of the Khubsugul region of Northern Mongolia and Southwestern Transbaikalia of Russia as exemplified by three key sections of the transboundary region united by the Selenga river basin.

The most active current aeolian relief formation in the transboundary territory of Northern Mongolia and Western Transbaikalia of Russia occurs within the Selenga basin where the main centers of aeolian relief formation are sand massifs in intermontane basins, river valleys and the windward slopes of low mountains.

By using the inputs received from the field work carried out in recent years (2018-2019) by the researchers of the Sochava Institute of Geography SB RAS, together with colleagues from the Institute of Geography and Geoecology of the Mongolian Academy of Sciences, it is possible to assess the nature of the modern dynamics of aeolian processes in this territory, based on the analysis within three key study sites located on the eastern coast of Lake Khubsugul, the Uure-Gol river valley in the Eastern Khubsugul region of Mongolia and the western part of the Chikoy-Khilok interfluve of Western Transbaikalia of Russia.

The study was carried out with a wide use of geomorphological, geobotanical, comparative-geographical methods, as well as the latest methods of remote sensing using unmanned aerial vehicles with the construction of orthophotomaps of aeolian massifs and three-dimensional models of overflying territories. Three key areas - on the eastern coast of Khubsugul, the valley of the Uure-Gol river in the Eastern Khubsugul region and at the western end of the Malkhan ridge (Mankhan-Elysu stow), differing from each other in many natural parameters, are assessed geomorphologically and geobotanically and their comparative geographical analysis was carried out.

A preliminary analysis of the current state of the relief and plant communities of the considered regions of Northern Mongolia (Khubsugul) testifies that at present, in the climatic situation in the main part of the habitats, some stabilization of aeolian processes is observed due to the wide development of vegetation cover and relatively high moisture content of the coastal sands of Khubsugul. As a preliminary forecast scenario, we can assume here a stable development of plant communities with a decrease in pasture load.

The least developed vegetation cover is observed in the Mankhan-Elysu stow as the most significant in area of all considered. Plants here have no time to form a sustainable community where they could hold the drift of sandy material. It can be expected that, the state of vegetation cover in this stow will probably keep the current structure without a pronounced trend towards development or degradation.

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PALEOECOLOGY OF LAKE ILCHIR'S CATCHMENT IN HOLOCENE AS A BASIS FOR UNDERSTANDING THE MODERN REGIONAL VEGETATION STRUCTURE

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Palynological records from inland regions are important for understanding past changes in vegetation and landscapes, and assessing the sensitivity of ecosystems in these regions to future climatic variations that determine the structure of vegetation cover. The results of palynological analysis of the bottom sediments from Lake Ilchir, located in the Republic of Buryatia, make it possible to reconstruct the structure of vegetation in the lake basin and its catchment and to understand the process of its changes in the Middle-Late Holocene. The obtained results of pollen analysis are unique, since they improve the nature of changes in regional vegetation with an average time resolution of about 125 years. Moreover, a reliable age model provides intra- and inter-regional correlations of environmental changes in order to understand the possible causes in the regional vegetation.

Bottom sediments of Lake Ilchir were retrieved in 2013. The length of the core was 133 cm; it was sampled at the Institute of Geochemistry of the SB RAS (Irkutsk), cut into every centimeter. The pollen grains and spores were extracted using the standard method [Berglund, Ralska-Jasiewiczowa, 1986].

The age of core deposits was determined by accelerator mass spectrometry radiocarbon dating.

Based on statistical analysis, three spore-pollen zones are identified that correspond to the three stages of vegetation development in the Lake Ilchir catchment. The first, oldest stage, lasted from about 8490 to 5620 years ago, was characterized by the widest development of Siberian pine forests in the forest belt of the Eastern Sayan Mountains with the admixture of fir, larch, Scots pine and birch. Meadow groups, mostly of Phleum timothy, prevailed in the local vegetation. Later, 5620 - 3730 BP, the presence of higher abundance of fir's pollen indicates a milder climate, with warmer winters and rather high snow cover, which prevents freezing of soils and supported the development of fir forests in the East Sayan highlands. In the latest stage of vegetation evolution in the lake basin 3730-1970 BP a decrease in the fir pollen abundance, timothy grasses combined with an increase in sedge pollen, meadow forbs indicates an increase in climate continentality (particularly, cooling in winter).

Thus, the newly obtained results show that the vegetation in the basin of Lake Ilchir developed gradually over the Middle-Late Holocene, without sharp changes in its composition. In the interval from 8490 years ago to almost 3730 years ago, fires occurred probably in the immediate vicinity, which led to a high concentration of charcoal microparticles in the Lake's sediments. Later 3,730 years ago a sharp decrease in the charcoal microparticles indicates that local fires have become insignificant. The most plausible reason of this could be the depletion of the woody vegetation cover and an increase in soil moisture due to low evaporation and to cold weather.

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ECOLOGICAL AND GEOGRAPHICAL PREREQUISITES FOR THE ANTHROPOGENIC TRANSFORMATION OF THE NATURAL ECOSYSTEMS IN THE AMUR REGION

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The Amur Region is a vast geographic area (1855 thousand km^2), which has extremely diverse, sometimes very contrasting, even in small areas, natural conditions. The relief is diverse and represented by alternating mountain systems and plains, causing a high mosaic of conditions, the formation of a dense river network, many lakes, mountain-tundra, forest, meadow, floodplain and swamp landscapes. There are more than 61 thousand lakes and 100 thousand rivers in the Amur basin, while the largest number of lakes are characteristic of the Verkhnezeyskaya and Zeysko-Selemdzhinskaya plains, where there are areas with a lake coefficient of more than 2%.

The climate is characterized by a high degree of continentality with a pronounced influence of monsoon features, especially in the Amur basin from the confluence of the Shilka and Argun rivers to the mouth. On the whole, in the northern Russian part of the Amur Region, climatic indicators correspond to a moderately cold, cold and extremely harsh climate, while in the southern, mainly Chinese, temperate, monsoon with subtropical features.

The vegetation and fauna are quite rich and diverse and are represented by six types of flora and fauna. However, a feature of the biota of the Amur Region is the pronounced border character of the ranges of many plants and animals species living here (for example, birds have more than 40% of the species composition), as well as a large representation of rare (listed in the Red Data Books of Russia and the subjects of the Federation), small and environmentally conservative species, which initially significantly affects their resistance to the effects of natural and anthropogenic factors.

Significant rearrangements of the valley complexes and, above all, floodplain ecosystems are caused by the flood activity of the Amur and its tributaries, which regularly manifests itself during periods of high water content. During major floods, the height of the flood wave can reach 18–20 m in the highlands (Khingan narrowing) and 8–10 m in the plains. The width of the flooded floodplain may exceed 30 km. Floods and powerful riverbed processes erode the banks (sometimes up to 10–20 m per year), braid bars and islands and form new ones, change the “pattern” of the floodplain.

Dry periods that occur periodically in the Amur Region create conditions for the formation of an increased fire danger in the region, which every 22-23 years leads to catastrophic fires that destroy natural ecosystems on hundreds of thousands and millions of hectares of territory.

Against the background of the seasons of summer-autumn monsoon rains periodically forming in the Amur basin and the accompanying floods, as well as periods of dry years replacing them with an increased fire hazard, the influence of these natural factors on ecosystems is strengthened due to human faults. Deforestation over vast areas leads to the destruction of their water-regulating functions, increasing the rate of floods formation and the degree of their catastrophism. The increased discharge of water from reservoirs of hydroelectric power plants and other hydraulic structures during the monsoon rains, as well as the construction of linear structures (embankments of railways and highways, etc.) without a sufficient number of culverts across the flow of flood waters leads to an increase in the height of the flood wave.

An increase in the number of man-made fires in dry periods, as well as long-term floods, leads, on the one hand, to an increase in the direct loss of natural communities, especially during the productive period for animals, and, on the other hand, as well as logging, it contributes to deforestation, increased flood levels, as well as pollution of watercourses and reservoirs as a result of surface runoff from fires.

In addition, long-term high floods and extensive fires can not only radically transform the affected ecosystems, but also significantly change the functioning of ecosystems in neighboring territories (changes in the phenological phases of plants, the timing and intensity of local and seasonal migrations in animals, etc.)

CURRENT ECOLOGICAL STATUS OF SNOW COVER AND ICE ON THE SOUTH-WEST COAST OF LAKE BAIKAL (ON THE EXAMPLE OF GOLOUSTNENSKOYE SETTLEMENT)

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To assess the current ecological state of snow cover and ice on the South-West coast of lake Baikal, snow and ice samples were taken in the winter of 2015-2019 near the following localities: Bolshoe Goloustnoe, Maloe Goloustnoe, Bulunchuk, and sampling was also performed on the riverbed of the Goloustnaya river and in the Baikal water area adjacent to the settlements under consideration. The following parameters were determined in the selected samples: pH, suspended solids, sulphates, nitrogen-containing substances and heavy metals.

The research area on the South-West coast of the lake is currently actively developing in the tourist and recreational direction, resulting in the development of various tourist facilities in the coastal part of the lake. Lake Baikal, including, and also increases the anthropogenic load on the components of the natural environment. There are no industrial enterprises in settlements located on the South-Western coast of lake Baikal. Pollutants also enter this territory together with atmospheric emissions from Irkutsk-Cheremkhovsky and Yuzhno-Baikal industrial units and local heating installations. Road transport emissions also contribute to air pollution.

Due to the lack of established levels of critical load for snow cover and ice, to assess the current ecological state of the lake coast. Lake Baikal, the results were compared with the established maximum permissible concentrations (MPC) of harmful substances for surface waters for fisheries purposes (ORDER of April 28, 1999 N 96). The results were also compared with regional background values for surface water.

As a result of the analysis, it was found that the samples of snow and ice considered by the content of sulfates, nitrogen-containing substances and strontium, Nickel, and cobalt meet the established sanitary standards. High levels of suspended solids, SO4, Mn, Cu, Zn, Pb, as well as high pH values are observed in sampling sites near localities: Maloe Goloustnoe and the settlements of Bolshoe Goloustnoe and Bulunchuk, as well as at the mouth of the river. Goloustnaya, and on the coastal part of lake Baikal, where pollutants probably come from emissions from local boilers, along with the North-West wind along the valley of the Goloustnaya river and with the exhaust of vehicles moving on the ice of the lake. According to the results of the study, it can be concluded that a focus of anthropogenic pollution is formed in the coastal part of lake Baikal. At snow sampling points located at a sufficient distance from localities, the concentrations of the substances in question correspond to the MPC and background values.

SESSION 4. «NEW METHODS AND TECHNOLOGIES FOR PROCESSING GEOGRAPHIC INFORMATION USING REMOTE SENSING, GIS AND MATHEMATICAL MODELING IN RESEARCH OF ENVIRONMENT AND SUSTAINABLE REGIONAL DEVELOPMENT»

THE USE OF ENVIRONMENTAL PREDICTORS IN THE CREATION OF FORECAST MODELS FOR THE DISTRIBUTION OF HABITATS OF RARE AND ENDEMIC PLANT SPECIES IN CENTRAL ASIA

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Central Asia is a large historical and geographical region of Eurasia which includes following physiographic parts: the Turan lowland and mountains of Kopetdag, Pamir-Alay, Tien Shan, Dzhungar Alatau, Saur and Tarbagatay.

The native Central Asian flora is distinguished by its outstanding richness, diversity, originality and high rate of endemic genera and species of flowering plants. Scientists have noted this fact and considered Central Asia as a separated area of Tethyan (Ancient Mediterranean) subkingdom of the Holarctic Kingdom, which occupies the territory of the internal runoff of Asia with the cold deserts, arid and mountain steppes (Popov, 1927; Grubov, Yunatov, 1952; Grubov, 1959, 1963; Kamelin, 1973, 2017). This territory is characterized by morphologically distinctive and systematically isolated unique relicts of the ancient desert flora (Grubov, 1959). For example, a specific flora of Central Asian variegated outcrops includes over 1,400 plant species, 540 of them are endemics (Kamelin, 2017). Their genesis is associated with the synergy of several environmental factors - predictors of the Upper Paleozoic (Carboniferous – Permian), such as arid climate and soil chemistry.

The definition of the role of environmental predictors is the key question in the study of the historical development of endemic flora and determining the causes of a survival of relict species to date. Currently, the maximum entropy modeling with the Maxent software is widely used in botanical researches for identification of the ecological niches of rare and endemic species; this method allows the development of targeted measures for their protection.

Our research is dedicated to the assessment of the current state of rare and endemic species using GIS-based analysis of data (variables) on environmental predictors of their habitats.

It has been found, that the historical tendency of the distribution of species of the modern flora within key speciation centers of Central Asia can be estimated with high reliability (AUC 97-99%) using 19 bioclimatic data (BIOCLIM) of the following geological periods – LIG (Last Inter Glacial, 140 thousand years ago), LGM (Last Glacial Maximum, 20 thousand years ago), MH (Mid Holocene, 6 thousand years ago). In addition, it is possible to create a model of the species response to different climatic scenarios (RSP2.6, RSP4.5, RSP6.0, RSP8.5) using the BIOCLIM method (Nix, 1986). It allows to identify following zones within the modern range of the species: 1) areas with a high level of impact (areas where the species is currently growing, but which will become unsuitable in the future); 2) areas situated outside the ecological niche of the species, both in modern conditions and in the future; 3) low impact areas suitable for the species in present and in the future climate; 4) expected new habitats (areas where the species is currently absent, but where it can potentially spread in the future). However, our study showed that this method not always give good results in distribution modeling of rare and endemic plant species of Central Asia. The combination of BIOCLIM data with soil predictors (bed type, physical and chemical characteristics of the soils) allows us to create more accurate and reliable forecast models for the distribution of relict endemic species that are strictly confined to specific types of soils of ancient origin.

In addition, the predictive mathematical models of regression or progression of rare plant communities (GLM), changes in their spatial structure (Kernel Density) and the succession in a specific habitat in conditions of destabilization can be created by comparing the data on the previous and current state of variable predictors using the Kernel Density, Generalized linear models (GLM) and Non-metric multidimensional scaling (NMDS) analyzes of the R software.

MODERN LANDSCAPE DIVERSITY OF ASIA REGIONS

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Landscape diversity creates the basis for the preservation of life on Earth. To evaluate it, geographic information models of potential and modern landscape diversity were created on the territory of Eurasia. The first is built on a landscape map of 1:18000000 scale. The method of creating the map (Baryshnikov, Krupochkin, 2016) involved calculating an indicator of diversity, taking into account both the number of species and the ratio of their areas, within operational cells. Trapezoids of the degree network were taken as such cells. Further, on the basis of a digital model of landscape diversity, an isoline model of this indicator was built.

Based on the data of remote sensing of the Earth (ERS) (Puzachenko et al., 2002; Baryshnikova, Krupochkin, 2009), maps of the current state of landscape diversity were obtained. To solve the tasks of automating the calculation of indicators of the entropy measure of heterogeneity of the landscape drawing and cartographic visualization of the results, the basic ArcGIS modules were used. After multi-stage processing of images, a model of the modern landscape diversity of the territory of Eurasia was obtained (Baryshnikova, Krupochkin, 2014). The model shows a significant decrease in landscape diversity. This was due to the increase in agricultural land.

In Europe, 21% of the area is agricultural land and 2.5% in cities. In Asia, the share of agricultural land reaches 53% of the total area of this part of the world, and another 2% falls on settlements. The rapid population growth in Asia has led to the need to expand the area used in agriculture. According to FAOSTAT (2009), the share of agricultural land in Turkmenistan is 69%, Uzbekistan - about 63%, China – 57.6%, Kyrgyzstan - 56%, Tajikistan - 33%. By the depth of transformation of the landscape structure, China and India are especially distinguished, where the share of reclaimed land reaches 44.4 and 35.9%, respectively.

It is important to note that the increase in agricultural land in Asia has led to fragmentation of the habitats of wild animals, caused an increase in the anxiety factor and provoked a closer interaction between them and humans.

The consequence of this may be new diseases, an increase in the frequency and intensity of forest fires and other negative processes. A further decline in biodiversity, which is observed both in Asian countries and in European countries with a high population density. For this reason, as one of the main criteria in assessing the current level of landscape diversity, quantitative estimates of population density can be used.

A schematic map of modern landscape diversity, based on remote sensing data and taking into account the population density and density of the territory's transport network, shows a decrease in landscape diversity in densely populated areas from 0.8-0.5 to 0.4-0.03 bits Such a decrease provokes a catastrophic reduction in biodiversity.

Losses from a decrease in landscape (territorial) diversity inevitably affect biodiversity, since in isolation from the territory on which the species live, it is impossible to preserve existing species and the appearance of new species without maintaining its landscape diversity.

ORGANIZATION OF DIGITAL ENVIRONMENTAL MONITORING: PROBLEMS, SOLUTIONS

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Currently, in Russia and the world, digitalization is a leading trend in technological development, this is due to a breakthrough in the development of digital technologies, an increase in the capacity of computing clusters, the emergence of 5G networks, the Internet of things, and cloud computing. Digitalization refers to the process of implementing cyber-physical systems, integrating sensors into all hardware components, and replacing physical or analog resources with digital data. Thus, digitalization involves a systematic approach to the use of digital resources and the introduction of digital technologies to achieve specific goals.

Large volumes of thematic and space-time environmental monitoring data, a significant number of existing software and hardware complexes for solving environmental problems, as well as the development of departmental data transmission systems and the Internet, justify the need to create a digital platform as a software product that accumulates the necessary latest technologies, providing users with access to information (data), services for their processing, Analytics, and, most importantly, to customers, manufacturers, and other users. This system algorithmizing relationships with the participants, United by a common information environment, provide architectural stack of software and hardware required to store and analyze digital data, leading to reduced transaction costs, through the use of a package of digital technologies and change of management division of labor (Mesropyan, 2018).

Every developed digital platform is built around a mass process, ensuring interaction between consumers and suppliers. Digital environmental monitoring can be considered as such a process. As participants in a unified information environment supported by a digital platform, researchers get new forms of research organization that were not possible before.

This highlights the scientific importance of conducting interdisciplinary research on the development of digital platforms using end-to-end technologies and filling them with mathematical and information models of individual processes in General, supplemented by tools for collecting and analyzing spatial and temporal data for environmental monitoring of territories, including remote sensing data and data from ground-based sensor networks.

The paper focuses on creating digital tool and infrastructure platforms for supporting environmental monitoring.

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DECLINED SPRING SNOW DEPTH OVER THE QINGHAI-TIBETAN PLATEAU INDUCED BY INCREASED MINIMUM AIR TEMPERATURE FROM 1960 TO 2013 BASED ON METEOROLOGICAL OBSERVATIONS

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With an average altitudes of above 4000-m and an spatial coverage of about 2.5×10^6 km^2 in Northern Hemisphere middle latitudes, the Qinghai-Tibet Plateau (QTP) is widely known as the "Asian water tower" and worked as the "heat pump" of the Asian monsoon, which is a window of changing climate of Asia. Snow cover is one of the most important land cover types on QTP. Compared with other seasons, spring snow cover on the QTP is especially crucial for its importance in snow water estimation, vegetation growth, and summer climate projections. Published studies have reported a general weak negative trend for the spring snow depth over the QTP from ground and satellite observations in different time intervals. However, limited by short time span of satellite observations, large uncertainty of passive microwave satellite observations in snow detection, and complex topography among the QTP, the real spring snow depth conditions and its attribution over the QTP remains unclear. Using 75 snow depth records and associated key climate (temperature, precipitation) variables from meteorological stations obtained the China Meteorological Administration (CMA), this study reported a subtle change of spring snow depth in QTP from 1961 to 2013, but a significant decline trend of spring snow depth at a speed of -0.54 mm $decade^{-1}$ ($p < 0.05$) during 1982-2013 from Cramer-Test analysis. The attribution of spring snow depth further demonstrated that, compared with anomalies in precipitation, changes in spring temperature dominated the snow depth variability over the QTP, which is driven by rapid rising of monthly minimum temperature in further. Since widely used reanalysis datasets (*i.e.*, ERA-5, ERA-Interim, and CRU TS) only provide monthly-mean temperature, their performances in snow depth and climate changes will be limited. Thus, the combination used of ground and reanalysis datasets is necessary to provide better understanding of climate change over the QTP in future studies.

ENVIRONMENTAL PROBLEMS OF THE DEVELOPMENT OF TRANSPORT IN THE TRANSBOUNDARY REGION AS EXEMPLIFIED BY THE BAIKAL BASIN AND ITS CARTOGRAPHIC STUDY

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The impact of transport on the environment is manifested in the process of its construction and economic activity. Also, environmental pollution is carried out by stationary sources in transport. The peculiarity of the geographical position of the Baikal basin lies in its transboundary nature. The region covers the territory of two countries - Russia and Mongolia, therefore, the solution of environmental problems associated with economic activities in this territory, including transport and environmental issues, has a special interstate regulation. Almost all types of transport are represented on this territory: railway, automobile, river, air. Each type of transport in its own way affects the environment. Railway pollution occurs along the railways and from stationary railway enterprises. The greatest pollution occurs along the Trans-Siberian Railway, since this highway has the highest train traffic intensity.

Automobile transport, with a constant increase in the number of personal vehicles and traffic intensity, is the main source of air pollution. The most significant pollution is manifested in settlements, especially in large cities. Increased pollution in large cities is associated with high traffic. Road congestion creates another problem - the formation of traffic jams. Slow traffic on the streets leads to the fact that the time spent on the trip increases and, accordingly, the amount of emissions into the atmosphere increases. Also, in human settlements, noise from vehicles affects human health. In addition, the impact of road transport is associated with the construction of new infrastructure. During the construction of roads, significant land areas are alienated. So, the construction of 1 km of a modern highway requires up to 10 - 12 hectares. Additional areas for transport equipment, warehouses, temporary structures, etc. are allotted. The impact of motor vehicles on the environment outside settlements occurs along roads. Another factor affecting vehicles is the formation of linearly extended ranges of increased dust pollution in the surface air layer. In the steppes of Mongolia and on the coast of Lake. Baikal there is a problem of off-road traffic, which harms the vegetation and leads to local transformation of local landscapes.

The impact of water transport is associated with the loss of petroleum products during loading at ports, discharges of polluted water. Together with engine exhaust gases, oil, unburned fuel and other substances fall into the water. The most common pollutants that are transported into the water are oil and petroleum products. Navigation in this territory is conducted on Lake Baikal and Lake Khubsugul, the Angara and Selenga rivers. The largest ship owner engaged in economic activity in the water area of Lake Baikal is OJSC East Siberian River Shipping Company (OJSC ESRSC). Vessels of OJSC ESRSC deliver contaminated household and base water for treatment to the Samotlor integrated waste processing vessel at the port of Baikal. The fleet of third-party organizations regarding the collection of sub-base waters is serviced on a contractual basis. The remaining vessels produce uncontrolled discharge of these waters throughout the lake. This problem has become a priority among the environmental problems of Lake Baikal (State ..., 2018). Control over the use of small vessels in the water area of Lake Baikal was carried out by the Centers of the State Inspectorate for Small vessels of the Main Directorate of the Ministry of Emergencies of Russia for the Irkutsk Region and the Republic of Buryatia.

The main problem of air transport is noise, which significantly degrades the quality of life in areas adjacent to the airport. To summarize, we can draw the following conclusions. Significant environmental pollution is caused by road transport. And the most significant pollution occurs in large cities. Rail pollution occurs mainly along the railways. Water transport pollution occurs during the transshipment of petroleum products and the discharge of waste water. The effect of air transport is mainly noise, as well as emissions of exhaust gases into the atmosphere.

WEBGIS-BASED NATURAL DISASTER INFORMATION SYSTEM OF NORTHEASTASIAN

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We have constructed North East Asian natural disaster information system utilizing open source WebGIS framework. Through comparisons and researches on different WebGIS system structures, implementation patterns, spatial database management patterns and several popular software, open source WebGIS platform MapServer, PostgreSQL+PostGIS (spatial database and spatial data engine), client-side browser framework open Layer were used. This system have basic function of web information publishing, spatial data storage and management, and it collects natural disaster information that have been publishing on the internet through grabing internet information, and based on the analysis to the text information, different kinds of natural disaster information databases were constructed. Additionally, locations of the disaster occurred were combined to provide map services, and the system is able to meet multi-user access issues, and have functions of thematic mapping, query and statistics, charting and output, et al.

TECHNOLOGY FOR CONTOURING OF FIOODING RIVERSIDE AREAS OF THE HYDROELECTRIC STATIONS' CASCADE OF THE ANGARA RIVER

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In the article a group of authors described methods for contouring of an underwater 3D relief and combined it with a surface in the conditions of incomplete initial data. The technology of building a relief model was tested under scope of scientific projects conducted at IDSTU SB RAS together with colleagues from other institutes of the Irkutsk Scientific Center related to complex studies of Lake Baikal, the Angara River and Bratsk reservoir. An algorithm for combining the underwater relief with the surface one is presented on the basis of heterogeneous initial data using the Delaunay triangulation. As a result of the combination a high-quality 3D model of relief is created. This model can be used to generate forecasts of changes in the riverside areas of reservoirs associated with discharges to hydroelectric power plants. The technology described in the work has been used to solve a number of practical problems and has shown its effectiveness. To combine data on surface and underwater relief, special software was developed using Delaunay triangulation algorithms. For data layers, their roles are indicated when constructing triangulation. The layers contain information about the land relief, water marks, coastline contours and underwater terrain. To work with the underwater terrain they use information about the marks of the water edge. From these data auxiliary triangulation is built, from which information on elevations is further extracted, to which the contours of the coastlines are tied and relative to which the depths are measured.

To assess the flooding and shallowing risks while regulating the modes of reservoirs and lower pools of hydroelectric facilities, a number of projects for the downstream water of the Irkutsk Hydroelectric Power Station and the Bratsk Reservoir have been carried out within the works of the Institute of Technology and Technology of the SB RAS and ISEM SB RAS. Using this technology the boundaries of possible flooding in the Angara River basin were obtained in the area from the dam of the Irkutsk Hydroelectric Power Station to the Bratsk Reservoir.

«STOCHASTIC MODELING»: APPLICATIONS IN GEOGRAPHY

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"Stochastic modeling" is a computer program developed at the Institute of Geography SB RAS. It is intended to support the formulation and solution of problems associated with the search for regularities of joint variability in the quantitative characteristics of various objects and with the construction of models focused on applied calculations of such characteristics.

Under the regularity in the framework of this technology is understood a stable property that limits the arbitrariness in the variability of characteristics that describe the state of the object. The densities of probability are used to model such constraints in stochastic simulation. A complete system of restrictions on the possible values of the controlled variables of the object is modeled by the density of their joint distribution. Particular constraints are described by models for calculating unconditional and conditional distribution densities for individual variables. As an indicator of the stability of the simulated property of an object, an estimate of the probability that this property is an invariant on any sample of the corresponding data on the variability of the characteristics of the studied object is used.

When modeling, two different objects can be considered as two realizations (or two different states) of the same object, if the identical in sense variables are used to describe each of them. The used by the program empirical data about the object is a formed in a certain way matrix of estimates of the values of these variables in different joint implementations. Such data may be a time series set of the characteristics of a particular geographic object. This can be a table of parameter values of the same type objects located in different parts of geographic space. The used data may also not have a temporal or spatial reference. Estimates of the values of variables can contain information about their accuracy. Such Information about the estimates on the values of variables is also taken into account when solving modeling problems. Files with data for the "Stochastic Modeling" can be prepared using standard versions of the «Ecxel» program.

The tasks of searching for patterns are realized by the postulation of many particular hypotheses and their check on the available data. The set of hypotheses is determined by the user of the program when setting a separate task and can be quite large. From it, the program selects a group of hypotheses (one or several) that, according to a given criterion, best reflect the desired regularity of the joint variability of the characteristics of the studied object. When testing each test hypothesis, the program constructs a stochastic model corresponding to it. Control and sense interpretation of the simulation results are performed by the user of the program.

The ordered tables of accumulated data on the values of the variables of the object, estimates of their unconditional distributions and descriptions of particular models intended for calculating conditional estimates form a stochastic model of the object as a system with concentrated parameters. Such a model is fully or partially used when performing applied calculations.

Typical applied tasks that are solved using the "Stochastic Modeling" program are predicting the temporal dynamics of hydrometeorological variables or calculating selected geographic characteristics at a certain spatial area. The approximate value of the corresponding variable calculated with using the model is being presented in the form of an estimate of the conditional distribution density with an additional indication of the confidence measure to it.

The program has a graphical interface and is equipped with a "User manual". The algorithmic tools included in it provide the researcher with the possibility to formulate a variety of problem statements, control the process of solving them, analyze and correctly evaluate the resulting simulation results.

AN ESTIMATION OF SEDIMENT YIELD IN THE WINTER LOW WATER IN THE CHANNELS OF THE SELENGA RIVER DELTA ACCORDING TO EXPERIMENTAL DATA

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Sediment discharge is the one of the main characteristics of channel erosion network. The study of its spatial variability allows defining basic physical and geographical factors of sediment flow forming; to estimate the role of natural conditions and contribution of different processes into single process of the rock destruction and movement of destructed material along hydrographic and channel network to the outlet. The aim of research is an estimation of water and sediments discharge of Selenga Delta during winter. Hydrologic exploration of the research area is rather weak: the closest gauging station is located in 127 km up-stream from main Selenga Delta bifurcation apex; stream gauges on delta's channels is absence, observations of delta's channels are made sporadically, mainly in summer. In freeze-up period observation are made rarely: the latest winter measurements were held in 2015 and 2019 yr.

The Selenga River delta are forming on the joint of interaction between river flow and receiving water body. Water flow is carried through the multiple channel system. The following cross-sections for the flow estimation were made: top of delta; Levoberezhnaya, Kharauz and Krasnoyarovskaya channels. The water discharge was obtained by detail analytics methods in March, 2020 yr. The top of a delta is the main control point – water discharge is 94 m^3/s; Levoberezhnaya channel water discharge is 25 m^3/s, Kharauz is 23 m^3/s, Krasnoyarovskaya is 34 m^3/s. Thus, the sum water discharge from 3 gauging points is 82 m^3/s. This is 87% from top of a delta water discharge. Thus, the remaining 13 % (12 m^3/s) of the flow passes through the channel network in the middle and central part of the Delta.

Beside water discharge measurements was applied approach to measure suspended sediments in winter season by sediment traps. The sediment trap represents a permeable bag connected with a plastic cylinder. The bag is using as a water filter. The sediment traps were installed on velocity verticals according to points of detail water velocity measurements. Time range between installing and getting up of sediment trap was used for calculating of sediment particles, traps were got up after several days after installing. As the result of analyze was received quantity values of sediment discharge for three channels and for the top of a delta. In the head of a delta sediment discharge was $3.84*10^{-9}$ kg/s (0.33 grams per day), in Krasnoyarovskaya channel – $3.46*10^{-9}$ kg/s (0.30 grams per day), in Levoberezhnaya – $4.44*10^{-9}$ kg/s (0.38 grams per day), in Kharauz – $2.46*10^{-9}$ kg/s (0.21 grams per day). It is important to say, that on a most part of all lifted sediment traps richly amount of water plants and other organic particles were observed. Organic mass takes from half to two-thirds of all mass of sample. It can be concluded that, in general, the discharge of suspended sediments in the channels of the Selenga river delta almost the same, significant discrepancy are marked due to different amount of water plants and organic fine particles, which explains by availability of organic income sources closed to cross sections. There are own income sources of suspended sediments for each channel. The main source is river bed and banks. The composition of suspended sediments can be equally represented as organic suspended particles as well as mineral. Sometimes the proportion of mineral and organic particles reaches 1:2.

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LAND USE/LAND COVER CHANGE AND UNDERLYING DRIVING FORCES IN HEILONGJIANG(AMUR)RIVER BASIN

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Land use/land cover (LULC) change is one of the most important parts of global change. It plays an important role in global environmental change and sustainable development. LULC has been included in the core project of "International Geosphere and Biosphere Program (IGBP)". In this paper, we take RS and GIS as the main technical means to expounds the characteristics of LULC in the Heilongjiang (Amur River) basin. In terms of quantity, structure, dynamic degree and degree as well as regional differences, we analyze the landscape pattern of the whole research area from 2005 to 2015 and reveal the primary and secondary factors leading to LULC. Finally, some countermeasures are put forward for the sustainable development of land resources.

TECHNOLOGY OF STUDYING THE NIVAL-GLACIAL FORMATIONS OF THE MUNKU-SARDYK MOUNTAIN RANGE

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In the present interglacial period there is a warming of the climate. Small nival-glacial formations (glaciers, snowmen) are convenient objects for observing climate change. The Munku-Sardyk mountain range is one of the most studied areas. S.P. Peretolchin has been observing the glaciers of this massif since 1900. In the present time, the scientists of the Institute of Geography of the Russian Academy of Sciences and Irkutsk State University have been monitoring the area since 2002 (Kitov et al, 2015). Monitoring is carried out over the main glaciers: Peretolchina (northern), Peretolchina (southern), Radde, Pogranichniy Glaciers. During this time, several methods and technologies of studying mountain geosystems have been developed.

The geomorphological structure of the study area represents an eight-step structure. The structure was formed thanks to the glaciation that took place here, starting with the most powerful one - the Okinskiy glaciation. There is a thermochron on each stage. This allows you to track temperature changes depending on the altitude location of the geomorphological stage. The minimum Peretolchina thermometer allows the measurement of the minimum temperature to continue since 1900. Although according to the thermochrons there is an increase in the average annual temperature, the minimum temperature practically does not change and is about -35°C.

Dendrochronological studies represent a different method of climate tracking. In addition, an ancient larch stump was found, which grew 7,500 years ago. The study of the sawing of this tree revealed that the climate in the optimal period of the Holocene was much warmer. The annual rings of modern trees are twice as old as that of an ancient tree. Studies of the growth rate of modern trees between the ages of 300 and 400 years confirm climate change and corresponding changes in glacier reduction (Suvorov, Kitov, 2018). We have identified an increase in the boundary of the forest.

The methods and technologies for studying glaciers based on Earth remote sensing data are the most informative for tracking the boundaries of glaciers. For 100 years glaciers have been reduced by half in area. Glaciers of Southern Siberia are showing a tendency to self-preservation. They are covered with superficial moraines. For example, the boundary of the open part of the Radde Glacier has risen 150 m since 2006. The field of surface moraines is 550 m long

For the first time, georadar research using georadar Oko-2 is being carried out on the Peratolchina and Radde glaciers. These measurements showed that the volume of the Peretolchina glacier decreased by 3.7 times in 100 years. The initial volume was determined by a mathematical model based on the reconstructed area, according to S.P. Peretolchin data and data ERS.

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GEOINFORMATION ANALYSIS OF ZONES WITH SPECIAL CONDITIONS THE USE OF TERRITORIES FOR SUSTAINABLE REGIONAL DEVELOPMENT

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Zones with special conditions for the use of the territory are established in accordance with the technical regulations on the safety of buildings and structures, which is necessary to ensure the protection of life and health of citizens, as well as their property, and environmental protection.

The mapping of the indicated territories in which there are restrictions on economic activity is regulated by the town-planning and land legislation of the Russian Federation, the documentation of territorial planning, town-planning zoning and territory planning.

According to the Federal Law of July 13, 2015, Federal Law No. 252 "On Amending the Land Code of the Russian Federation and Certain Legislative Acts of the Russian Federation", from January 1, 2016, zones are subject to description and entering into the register of borders of the Unified State Register of Real Estate. The creation of a zone with special conditions for the use of the territory implies certain legal requirements and restrictions on the operation of real estate.

In order to analyze placing of zones with special conditions for the use of territories within the boundaries of the city of Nizhnevartovsk, natural objects and objects of engineering and transport infrastructure were studied. Currently, in the city of Nizhnevartovsk, the boundaries of the zones of these objects have not been set in detail, and information about most zones has not been entered in the Unified State Register of Real Estate, which determines the relevance of this study.

The main legislative documents governing the procedures for establishing zones with special conditions for the use of the territory, as well as related problems caused by the imperfection of modern legislation, are considered.

Using geoinformation mapping, a spatial analysis of zones with special conditions for the use of the territories of the city of Nizhnevartovsk, which are allocated in accordance with the norms of federal laws, is carried out. In order to study the rational and effective territorial planning and urban planning, the zones of the coastal protective zone, the water protection (fish protection) zone, the railway protection zone, the inundation and waterlogging zones and the aerodrome territory are mapped. As a result of the study, cartographic material was compiled showing a spatial analysis of zones with special conditions for the use of the territory within the city of Nizhnevartovsk.

The recommendations developed in the course of this study can be used by organizations, as well as specialists whose activities are associated with the design, location, construction and operation of facilities located in areas with special conditions for the use of the territory.

The allocation of zones with special conditions for the use of territories is carried out taking into account various factors, for example, water protection zones are established depending on the length of rivers and streams, the mirror area of water bodies. The width of the sanitary protection zone around the production facilities was established taking into account the sanitary classification, the results of the calculation of the expected air pollution and levels of physical impacts. All types of zones should be registered and reproduced in the graphic parts of the documentation of territorial planning and urban development. To conduct rational land use within the boundaries of these zones, it is necessary to develop an optimal solution, on the basis of which it is possible to organize the production process as efficiently as possible and use cadastral data in the interests of all participants in land relations, which is necessary for sustainable regional development.

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MAPPING THE GEOSYSTEM CHARACTERISTICS OF TRANSFORMATIONS OF THE NATURAL ENVIRONMENT OF LARGE REGIONS

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The transformation of geosystems is typically seen as changes in the environment due to anthropogenic interference (Sochava, 2005). In this context, potential and actual transformations are distinguished. The research of potential transformations is associated with a geographic forecast of possible changes in the state of the environment due to external impact, and current transformations include an assessment of its current ecological state.

Based on the electronic atlas "Baikal Region: Society and Nature", the problem of landscape-cartographic support for studying the transformations of vast territories is being solved. The main requirement for the content of the target block of maps is the reliability of the results of a comprehensive research and their evidentiality if used to make management decisions to optimize the environment. This aspect is realized through the integration of a multitude of geographical data on the structure of natural systems, their sustainability and trends of anthropogenic transformations into a single target cartographic information system (CIS).

The area under investigation includes the territory of the Baikal basin, and the northern regions of Mongolia. In the practice of studying various transformations of the natural environment, we often used landscape-interpretation methods (Mikheev, 2001; Konovalova, 2010). The objects of mapping are geosystems, considered as geographical spaces, where all the components of nature are closely interconnected with each other and interact with society (Sochava, 2005).

A logical and methodological coherence of small-scale target mapping of the natural environment of a vast territory has been developed. The analysis of natural structures was carried out and a basic inventory map of geosystems of scale (M 1:5 000 000) was created. We developed a set of geosystem characteristics and carried out an environmental interpretation of information and integrated environmental mapping, aside from that implemented geoecological zoning of the territory.

Based on the information synthesis of the obtained data and knowledge about the modern landscape structure of the region, the methods of polysystem analysis, we revealed the nature of sustainability, functions, value characteristics of geosystems and the patterns of their anthropogenic transformations. The presence of a single set of maps will provide a study of questions about potential and relevant transformations of geosystems. The small-scale maps of the Baikal region, compiled in a certain sequence on the basis of a single structural-hierarchical specialized classification, reflect a complex of environmental conditions that are important for making constructive-geographical, design, managerial, and environmental decisions.

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IMPLEMENTATION OF THE ENVIRONMENTAL LEGAL MECHANISM OF NATURE PROTECTION FOR REGULATING RECREATIONAL ACTIVITIES IN THE TERRITORY

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Recreational activities in any territory are associated with various types of impact on all components of ecosystems. Of all types of economic activity, it is recreational activity that directly depends on the preservation of the existing quality of the environment, as its main resource, which is a guarantor of attractiveness for tourists.

However, the conduct of economic activities in areas with a unique natural environment falls under very strict restrictions on the part of environmental legislation. A striking example is the Central Ecological Zone of Lake Baikal, which, as a result of the imposition of many environmental laws, falls into a system of severe ecological restrictions on economic activity, which makes sustainable economic development of these territories extremely difficult (Potapov, Dobrovensky, 2016) and greatly aggravates nature management conflicts.

For a competent resolution of this conflict, it is necessary to involve the mechanism of nature protection, which ensures the materialization of environmental and legal norms. The ecological legal mechanism is an independent institution of Russian environmental law, which manifests itself in the system of environmental legal norms and environmental legal relations aimed at fulfilling the environmental imperative enshrined in the law.

The result of the work of the entire mechanism is a legal relationship aimed at solving a specific economic problem. However, the effectiveness of the environmental right mechanism is not always associated with its effectiveness. The way out of this situation is to find the optimal solution, which is based on the principles of the priority of ecology, but in combination with the economy, namely, taking into account the potential ecological capabilities of the natural environment, the absence of irreversible consequences, the real likelihood of recovering losses in the natural environment.

To implement the environmental legal mechanism in decision-making in the current situation of multi-level environmental restrictions and a significant conflict of interest in the territory, the instrument of legal environmental zoning is used (Lesnykh, 2018), which complements the environmental legal mechanism of nature protection with a visual representation of the operation of environmental legal norms. This tool of information (legal) support for decision-making ensures the adequacy of management decisions through taking into account the objective and sustainable features of the region, visually represents the effect of environmental regulations and reflects contradictions in real and permitted use, which makes it possible to find the optimal option for using different sites, including for recreational purposes.

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INTERACTIVE MAPPING AND GEOSYSTEM ENVIRONMENTAL-EDUCATION FUNCTION OF NATIONAL PARKS

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Environmental education activity is an important function of protected nature areas such as nature reserves and national parks. It includes development of visible and available materials on tours and routes, geographical and environmental features of a territory, unique species of flora and fauna, etc. Interactive geoinformation maps with different thematic content are one of the way of visualization of this information

The interactive map of vegetation “Along the Doppelmair’s trail” is an example of such scientific information visualization. It isworked out for one of the remote and limited for visitation core area of the FSE “Zapovednoye Podlemorie” in the Barguzinsky Nature Reserve. We applied traditional geographical approaches and methods (field research, geobotanical descriptions) and modern GIS technologies (creation of unit database on landscape foundation, satellite image interpretation, infogram visualization) to create the map. As the result a GIS product is created with ArcMAP and located on the ArcGIS Online platform.

This map shows characteristic vegetation types, succession stages of pyrogenic dynamics of forest geosystems during past century. Infograms demonstrate information on sites with wild animal encounters, vegetation distribution, landscape features, and photographical materials collected during preceding field expedition research on the territory.

This interactive map is a way for nature conservation popularization and solution to some educational tasks addressed to the protected areas. It gives to people an opportunity to study via the Internet changes in vegetation from Lake Baikal shoreline to mountain peaks of Brguzinskii Range, learn about typical flora and fauna species, including endangered ones, find interesting historical fact about the reserve remotely, and, thus, sound out uniqueness and fragility of nature and meaning of conservation attempts. A complex of such interactive maps with different special content, developed for the national parks, is the basis for determining the educational functions and natural educational potential of geosystems for different protected areas. Moreover, it can be used for improvement of environmental management models and nature conservation activities.

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GEOINFORMATION ANALYSIS OF THE PERIOD OF THE STABLE SNOW COVER OF THE PRIBAIKALYE

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Currently, methods for remote indication of snow cover and its characteristics are actively developing (Dumont, Gascoin, 2016, Frei et all, 2015). One of the earliest, widely used and most valuable products is the "snow cover" product, obtained on the basis of MODIS images (Hall, Riggs, 2016, Tekeli et all, 2005).

The mapping and analysis of the period of occurrence of the stable snow cover (SSC) of the Pribaikalye for 2000-2010 was carried out. At the first stage, the dates of establishment and destruction of the SSC are determined using the eight-day MODIS "snow cover" composites with a spatial resolution of 500 m (MODIS/Terra Snow Cover 8-Day L3 Global 500 m Grid, Version 6), and the duration is calculated as the dates difference. A spatio-temporal analysis of the duration of the occurrence of a stable snow cover and the assessment of the influence of various environmental factors on it were carried out. It is shown that in most of the territory of the Baikal region, the SSC lies between three and nine months. The Baikalsky and Barguzinsky ranges are characterized by the longest occurrence of the SSC, about 95% of their territory was covered by the SSC from six to nine months. In the greater territory of the rest of the ranges, the SSC was laid for five to eight months. The Olkhon region is characterized by the shortest duration of occurrence of the SSC (three to six months). A multiple regression analysis of the relationship of the period of occurrence of SSC and environmental factors: the altitude (meters, digital elevation model (DEM) from the WorldClim dataset, spatial resolution 1 km), slope (degrees, DEM), potential total solar radiation income (kWh/ m^2 per day, calculated in the SAGAGIS based on DEM), as well as land surface temperature (Celsius degrees, according to MODIS) was carried out. The surface temperature was calculated as the arithmetic average of day and night temperatures according to the MODIS monthly data (MOD11B3: MODIS / Terra Landline L3 Global 6 km Grid SIN V006) for Januarys and Februarys 2000-2010. The coefficients of the equations of the multiple and pair regression are calculated. A high positive linear relationship was revealed between the period of occurrence of the SSC and the altitude for the whole territory, as well as for all ridges, except Khamar-Daban. In general, for the whole territory, the calculated increment in the period of occurrence of the SSC with a height is about 12 days for every 100 m. There is no linear relationship between the duration and the incoming solar radiation, which is determined by the slope and aspect. The average negative linear relationship between the duration of the SSC occurrence with temperature is noted.

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STUDY OF SEASONAL DYNAMICS OF LANDSCAPES OF THE ALTAI REGION BASED ON DATA FROM THE GLOBAL LAND MONITORING SYSTEM (LMCS) «COPERNICUS»

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Productivity of landscapes is the main indicator of the effectiveness of their functioning. The productivity index calculated from dry matter (DMP) can be used to analyze the dynamics of annual landscape production and phytomass growth. It reflects the overall growth rate or increase in dry vegetation biomass. This indicator is related to the net primary productivity (NPP) of eosystems and allows you to compare its values with data from agrostatistics (kg / ha / day). The gross dry matter production (GDMP) indicator of equivalent gross primary productivity (GPP) can also be used to study landscape dynamics. The main difference between DMP and GDMP is the inclusion of autotrophic respiration.

The data required for the study can be obtained from the Copernicus Global land service (CGLS) platform, which is a component of the Copernicus core land monitoring service (LMCS), the European flagship Earth observation program. The global land service systematically produces a series of qualified biogeophysical products on the state and evolution of the earth's surface on a global scale and from medium to low spatial resolution, supplemented by a composition of long-term time series.

Patterns of changes in the structure of climate seasons of the annual cycle since 1990 were established to study the seasonal dynamics of landscapes of the Altai region. The structure of the climate seasons of the annual cycle refers to the number of phases included in the season, their start and end dates, duration, as well as a set of qualitative characteristics of the state of nature in a particular phase of the season (Rutkovskaya, 1979; Filandysheva, Okisheva, 2002). The authors of the article studied the structure of the climate seasons of the annual cycle based on data from 21 weather stations located in the Altai territory and adjacent territories. Next, geoinformation models that characterize changes in the duration of phases, their start and end dates were built in the ArcGIS program. This allowed us to trace some patterns of spatial changes in these indicators on the territory of the entire region.

Further, data from THE lmcs Copernicus collection were obtained sequentially for the vegetation period of plants over a number of years. The index values were exported to ArcGis, where the DMP and GDMP values were taken at a given point using tools to get raster values, which were then exported from the layer attribute table to dbf format. Then the obtained data were compared with the data on the structure of the climate seasons of the annual cycle.

Studies have shown that the values of landscape dynamics parameters differ not only in different zonal conditions, but also due to the course of circulation processes that develop over the study area and reflect the characteristics of the underlying surface.

Data from the CGLS platform allows you to track the increasing influence of these factors during the vegetation part of the annual cycle.

BIAS-CORRECTED PRECEPITATION DATA FOR SOUTH SIBERIA

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Precipitation is one of the most important climate characteristics. They are the main source of moisture for the land. In climatology, precipitation estimationsare represented by a large number of climatic indicators (the sum of precipitation, intensity, periodicity, etc.) Assessing changes in the characteristics of extreme hydroclimatic phenomena requires accurate precipitation estimates with high temporal resolution and spatial scale. In this context, long-term datasets of global atmospheric reanalysis and climate model calculations are an important source of information, mainly because of their global coverage and long data range exceeding 30-35 years. Comparing reanalysis data with observation data at weather stations, significant differences are obtained. Therefore, various ways for downscaling and bias correction of the results of calculations of global climate models are suggested to improve the reproducibility of local weather conditions.

In previous studies, we compared the ERA-Interim reanalysis data with observations at weather stations and adjusted the monthly precipitation at the nodes of the reanalysis grid for the territory of South Siberia (Ryazanova, 2016). In this work, to study the hydrothermal conditions, it was decided to use the ERA5 reanalysis data (Copernicus, 2017), because this reanalysis was released relatively recently and replaced the of ERA-Interim reanalysis (Dee, 2011). The spatial resolution of the ERA5 reanalysis is 0.25×0.25°, which is approximately equal to 27.7 km in latitude and 16.5 km in longitude for the territory of Siberia. The time resolution of the data is one hour, and larger time periods (monthly) are also available for download.

Monthly precipitations (obtained from www.meteo.ru) for 133weather stations in Siberia during the growing season (May-September) from 1979 to 2017 were used for bias correction of the reanalysis data. Comparative analysis has shown that long-term average monthly sum of precipitations obtained from ERA5 reanalysis are higher than precipitation estimations from the observation data. The number of weather stations where difference between two data sets exceed 60% vary from 3 in July to 37 in May. To eliminate significant differences between reanalysis data and observation data, we have developed a specific procedure for correcting reanalysis data. As a result of the adjustment, the deviations of the reanalysis data from the observation data decreased (table). The difference after correction is lower than 60 % at all weather stations, and from 94 (July) to 118 (August) weather stations has difference lower than 30%.

The adjusted datasets provide an accurate and reliable information with high spatial resolution required for proper analysis of climatic changes on a mesoscale scale at waist areas of Siberia with sparse weather station network.

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METHODS FOR MAPPING INFORMATION ABOUT THE STRUCTURE AND DYNAMICS OF GEOSYSTEMS OF THE MOUNTAINS OF BAIKAL REGION

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Results from investigating the geosystems of Cisbaikalia in its western and eastern parts (Primorskii Range and Barguzin Range, respectively) are presented. For studying three parts of these mountain ranges (having a central part for the Primorskii Range and a central and south-easterly aspect for the Barguzin Range), the regional background and the main factors of the landscape differentiation of the study areas were analyzed. The areas of the testing grounds are 80-100 km^2 within the Central Ecological Zone of the Baikal Natural Territory.

For the analysis of the structure of geosystems and the estimation of disturbance, the basic geosystem approach is applied to modern geoinformation, cartographic and remote methods. Based on V.B. Sochava theory of geosystems it is assumed for use in processing and ordering a large volume of information. We analyzed the regional background and main factors of the landscape differentiation of the study areas. It is established that the main factors influencing the landscape diversity are the aspect and steepness of the slopes, the composition and structure of rocks, the absolute height, the amount of atmospheric precipitation, and anthropogenic impacts. It is determined that the influence of the lithomorphic factor is widespread throughout the study areas, the hydromorphic factor is also important, the cryomorphic factor occurs additionally in the alpine and goletz zones.

There are structural-dynamic characteristics of landscapes of a topological level. Structural features of topological geosystems are revealed, and large-scale maps (at a scale of 1:50 000) of key areas are compiled. Map of the landscape-typological structure was created on the basis of the structural-dynamic and facies analysis of landscapes. Regional, structural, and dynamic characteristics of geosystems are displayed in interconnected fields of the map and its legend, built on the basis of the cartosemiotic model.

APPLICATION OF GLOBAL SATELLITE MAPPING SYSTEMS IN GEOINFORMATION ANALYSIS OF ANTHROPOGENICALLY ALTERED LANDSCAPES IN THE BASIN OF LAKE BAIKAL

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Lake Baikal is a unique natural site and the largest reservoir of drinking water both in Northeast Asia and in the world. Therefore, monitoring the environmental state in the face of increasing environmental pressure is becoming an urgent task. Modern geographic research is inextricably linked with geographic information technology. The basis of studies of the anthropogenic impact on natural systems is the analysis of a multitude of data on physical and geographical conditions, the structure of economic activity, the level of pollution, the spatial distribution of pollutants, implemented through GIS technologies.

The electronic cartographic base, which includes data on the components of the landscape structure of the territory, is formed using various topographic and thematic maps, satellite images of various resolutions and territorial coverage, accurate GPS receivers, and constitute the base layers for the study and mapping of natural-anthropogenic systems. The emergence in recent years of digital elevation models of different spatial resolutions, comparable in accuracy with similar data taken from topographic maps, and the development of sophisticated spatial analysis methods have complemented, expanded the methodology of geographic information mapping and adapted it to the lake basin. Baikal. To obtain the contour lines of the relief, the SRTM model of the 4th version is taken as the basis, the data of which is a matrix of heights with a cell size of 3 arc seconds. This matrix was converted and scaled to 1:5 000 000, and all digital layers were integrated into a single map projection and coordinate system (WGS 84). Comparison of spatially linked relief layers and the hydrographic network in QGIS made it possible to distinguish the basins of large, medium, and small tributaries of Lake Baikal.

When identifying the boundaries of the contours of anthropogenic-disturbed territories (plowed and residential areas, fires, deforestation, knocked-out lands), satellite images of regional coverage and global information systems for changing forest cover Landsat Forest Cover Change, maps of global changes in forest cover in the 21st century, High- Resolution Global Maps of 21st-Century Forest Cover Change, a global map of the types of vegetation cover ESA Glob Cover 2009. Which are necessary when mapping large areas, since the collection and storage of data with subsequent processing is sufficient full-time, and the availability of global information databases contains already processed mosaics of satellite images, reduced to a single scale and coordinate system. The resulting synthesized electronic layers allow us to analyze and map land use and land cover, and their derivatives.

The influence of certain types of natural and anthropogenic impacts on the study area is increasing, a pyrogenic factor, felling and grazing have a particularly negative effect on the structure of the soil and vegetation cover. Violation of the state of the environment in part of the complex or landscape, entails a change in the ecological situation in other parts. Therefore, an integrated approach is needed, using modern GIS technologies in combination with global satellite monitoring data, which allow us to study at the regional and subregional scale level the influence of factors that change the natural framework of the territory and the ways of their leveling.

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METHODS OF ASSESSMENT AND MAPPING PHYTOMASS PRODUCTION FUNCTION

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Structure of the landscape has a significant impact on its functions. The phytomass production function was estimated on six study areas which are located in different parts of Lake Baikal (Barguzin mountain range; the Priol'khon plateau, part of Khamar-Dabanand on the Primorsky mountain ranges, Ol'khon island, Selenga river delta) and exposed to different degree of impact. Fieldworks were conducted on 413 test plots in summer seasons from 2011 to 2019 years. we have been collecting data which include: characteristics of relief, soil, vegetation, water regime, etc. The descriptions of landscape characteristics (with special attention to soils and vegetation) were carried by the specially designed algorithm aimed to determine the quantitative values of landscape functions and factors of its formation. The net primary production of the tree stand, tree and herbaceous phytomass data was collected on the test plots. For these areas the landscape maps at fine scale were compiled based on the landscape approach, fieldwork data, DEM, and remote sensing. All data we connected with the landscape GIS of Baikal region. Compiled landscape maps were interpreted for assessment phytomass stock. Interpretation was made on the base of tree phytomassand above-ground herbaceous phytomass measurements in different landscapes types.

By the methods of statistical analysis, the climatic and landscape factors affecting the formation of phytoproduction function were determined at the local and regional level, and the correlation between phytomass accumulation function and structure and dynamical state of landscapes was reveal. The high direct correlation of phytomass values with geom units, which characterized also high-altitude zonation, is revealed. According to the results of the regression analysis, the more strongly the influence of psammomorphic, hydromorphic or stagnant factors on the formation of the landscape, the lower the phytomass values. The landscape maps can be information base for the spatial distribution and assessment of functions at a certain hierarchical level.

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THE STUDY OF ALTERNATIVE SOURCES OF INFORMATION IN THE RESEARCH OF LOCALIZATION AND MOBILITY OF THE POPULATION

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The purpose of this article is to develop a methodology for compiling population density and mobility maps based on the data (geographic data) obtained from mobile operators in Irkutsk. Before its development, Russian and world experience in compiling maps based on mobile phones data was analyzed.

To achieve the goal, the author uses information on the localization and movements of mobile phone users which telecommunication companies obtain. Currently, telecommunication companies have such a wealth of information about users that they can compete on equal terms with social networks. With appropriate processing, this information can provide a huge array of knowledge that cannot be obtained otherwise. After analyzing geospatial data, you can get accurate and, importantly, timely information and understand what processes take place in the city during the day. The information is accumulated in the call details record (CDR) which includes information about the location of the device at any time, a call log which contains the information about another subscriber, and data on Internet access sessions.

Using the data received from mobile operators (CDR),it was possible to identify information about the location of the device at any time. Based on the geographical location of base stations, you can analyze the density of users at a particular time at a certain moment. Subsequently, QGIS (open source geographic information system) implements the spatial distribution of the base stations and creates a relational table of various base stations with specific IDs. In addition, around each base tower, we get the number of users on working and non-working days. Compared to traditional data sources, such as official census statistics, mobile phone location data have an obvious advantage in statistical accuracy and timeliness. Thus, data on the location of a mobile phone can really reveal the spatio-temporal distribution of urban residents at macro- and meso-levels in administrative districts of the city.

Subsequently, the positions of the base station are processed by the spatial analysis tools “Voronoi polygons” in QGIS. Voronoi polygons are created on the basis of a network of mobile communication base stations, the number of times telephone connects to the network for a certain period of time (total, weekends, working days) is divided by the area within a certain polygon. Thus, we get the density of signals in a certain period of time.

The results obtained now clearly demonstrate that the geographic data from user devices and the geographic information systems represent a very effective symbiosis of technologies for solving geographical problems. Such studies make it possible to assess general mobility of population for a particular region.

Based on official sources of information (statistical compilations and population censuses), it is impossible to quickly consider the movement of population at the local level. However, despite their undeniable advantages, they are unlikely to replace traditional methods of studying mobility of population in the near future. Only a rational combination of traditional and new methods can cause a qualitative change in the accuracy and efficiency of population distribution.

LAKE AREA CHANGES AND CAUSES ANALYSIS ON THE MONGOLIA PLATEAU FROM 2000-2019

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The Mongolia Plateau, which is a typical arid and semiarid region and has been experiencing rapid warming over the past several decades, the lakes on the Mongolia Plateau experienced a rapid shrink process, and ecological environment is facing a severe challenge. Thus, the changing trend and driven factors research is of great significance to the scientific protection of lake resources, managing the local ecological environment and monitoring the dynamic changes of lakes on the Mongolia Plateau.

The study of the yearly changes of lake (> 1 km^2) on the Mongolia Plateau during 2000-2019 was carried out by using the global water dataset produced by JRC of European Commission. We analyzed the main factors that influence lake changes by collecting and arranging the meteorological data and human activity data of the two areas from 2000-2019 together with the multiple linear regression analysis method. The main research results in this study are as follows:

(1) Lake number and area of both Inner Mongolia and Mongolia all had two change trends during the past 20 years, and the time turning points were all in 2008. Lakes number and area of the two regions decreased from 2000 to 2008, and the shrinkage of lakes in Inner Mongolia (77,900.2 km^2) was severer than that in Mongolia (60,445.5 km^2). Lake number of the two regions and lake area of Inner Mongolia gradually increased during 2008-2019.

(2) Lake area changes in the Hulun Buir City and Xilin Gol League played a leading role in lake changes in the whole Inner Mongolia. The decrease of lake area of the two regions during 2000-2008 occupied a proportion of 86.8% of the total decrease of lake area of the whole Inner Mongolia. The increase of lake area of the two regions during 2008-2019 occupied a proportion of 89.4% of the total increase of lake area of the whole Inner Mongolia.

(3) Grazing intensity has statically significant negative effects on the lake area while precipitation had significant positive effects on the lake number on the Mongolia Plateau.

ON THE MODELING OF TRANSIENT PROCESSES IN MICROLOGISTIC TRANSPORT SYSTEMS

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Increasing the productivity of the regional transport system is one of the ways of economy sustainable development. The science-based designing of new micrologistic transport systems (micro-LTS) and/or improvement of existing ones are applied to solve this problem. The micro-LTS should provide the possibility of using multimodal transport (Paul A. Myerson, 2015). Such systems include, in particular, sea and river ports, transport hubs, freight railway stations, marshalling yards, etc. To study the operation of such objects, which are usually affected by random factors, it is necessary to use mathematical modeling. In this case, multiphase queuing systems (QS) are often used as the mathematical apparatus. A multiphase QS consists of a sequence of ordinary QS, each of which serves an incoming request (Medhi J., 1991).

Previously, we proposed an approach for determining stationary (steady-state) operation indicators of micro-LTS, which is based on the use of multiphase (usually three-phase) QS with group requests and blocking of channels (Kazakov A., Lempert A., Zharkov M., 2018). Each phase corresponds to a micro-LTS subsystem. On the one hand, channel blocking allows us to prevent the loss of requests between phases if there are no available places in the queue in the second or third phases. On the other hand, the presence of blockings leads to the appearance of nonlinear effects, in particular, complex transients, during which the behavior of the system significantly deviates from the stationary mode. However, when the system runs for a limited time, the transient process may not converge to a stationary one, or it may be a significant part of the operating time (Medhi J., 1991). Therefore, the study of transients in the QS is relevant.

Here we present systems of ordinary differential equations (Kolmogorov equations) that describe the distribution of transition probabilities of states for two-phase and three-phase QS with group requests. They are valid for various QS with a specified number of channels, a finite queue length at each phase, and an exponential distribution of request service time.

Besides, we suggest a generalized mathematical model of micro-LTS operation, which has the form of a multiphase QS. It uses the BMAP model (Lucantoni D.M., 1991) to describe the incoming flow of requests (passenger traffic, cargo traffic). BMAP allows you to join several sub-flows with various parameters, including the laws of request group size distribution and the intensity of their arrival. Based on the generalized model, we construct stochastic models of a transport hub that contains a railway station (passenger system) and a freight railway station (cargo system). The first model has the form of a two-phase QS, and the second one is a three-phase QS. We write down Kolmogorov systems for them, specify initial probability distributions that set Cauchy conditions, and solve the obtained Cauchy problems by the 4th order Runge-Kutta method. Numerical results allow us to conclude the nature of transient processes. Note that the choice of the system states' initial probability distribution has a significant impact on the strength of perturbations (jumps) and the duration of transients.

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THE IMPACT OF THE SUSTAINABLE DEVELOPMENT CONCEPT ON THE INDICATORS OF TRANSPORT ACCESSIBILITY AND AVAILABILITY

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For Russia, as a country with a vast territory, the question of its development remains relevant. And one of the essential conditions for this is the transport availability or network density, which refers to the spatial development indicators of the territory.

At present, the spatial paradigm becomes increasingly significant, and networks of the largest infrastructures in the territories of different regions are one of the main objects of such development. Thus, transport and logistic infrastructure forms a physical transport space based on the principles of sustainable development: economic, social, and environmental. (Vokhmyanina A.V., Zhuravskaya M.A., Petrov M.B., 2018). However, despite the fact that the theory of sustainable development is increasingly involved in all spheres of human activity, there are currently no reasonable quantitative indicators to measure the sustainability of the development of countries, as well as particular regions or territories (Erofeyev P.Yu., 2007).

Analysis of systems of sustainable development indicators shows that there are different approaches to their elaboration, and often the proposed systems have an excessive number of criteria. For example, the system of indicators of the UN Commission on Sustainable Development includes 132 criteria-indicators. According to (Tarasova N.P., Kruchina E.B., 2006), the abundance of indicators makes their use difficult in many countries due to the lack of statistical data.

The purpose of this study is to analyze the impact of sustainable development indicators on the transport accessibility and availability of territories. Taking into account that three spheres of human activity are equally important in the theory of sustainable development: economy, ecology, and social field, we propose three blocks of enlarged indicators affecting the transport accessibility and availability of the territory:

- technical and economic indicators of the territory:

$TEcI = \{ TEcI_1, TEcI_2, \dots \};$

- socio-political indicators:

$SPI = \{ SPI_1, SPI_2, \dots \};$

- environmental and geographical indicator:

$EnGI = \{ EnGI_1, EnGI_2, \dots \}.$

The known approaches to determining transport accessibility are well combined with the methodology we proposed but required some improvement. Earlier we proposed an approach that allows to evaluate and compare the transport system of the region (Kazakov A.L., Petrov M.B., Maslov A.M., 2013) not only from the position of covering of area or population or cargo flow but also from the view of functioning and interaction in the territory of different modes of transport, their ability to complement each other, given the advantages of each mode in terms of sustainable development of the territory.

The study found the need to diversify transport opportunities in terms of accessibility and availability. For example, there are territories where only one mode of transport operates, and this is not the same as several modes of transport. In modern conditions, it is essential to take into account the multimodal aspect of the transportation network, and hence the transport accessibility and availability areas, as a transport indicator in this territory.

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RAPID ANALYSIS OF THE CHANNEL PROCESS USING AN UNMANNED AERIAL VEHICLE

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Identifying patterns of long-term dynamics of channel-forming processes in various natural conditions for many decades remains one of the most pressing scientific problems. The study of channel deformations is necessary to prevent undesirable (from the point of view of life and economic activity) development of these processes and to use the regularities of their regime in the development of projects for the development of rivers and regulation of channels.

During hydrometeorological surveys, it is necessary to conduct a hydrologic-morphological analysis of the channel process of watercourses, including a preliminary assessment of the qualitative and quantitative characteristics of channel and floodplain deformations (directions of deformations, trends and intensity of their development).Accelerated analysis of the riverbed process of the watercourse in the absence of long-term observations with geodetic reference on the ground, can be done using remote sensing of the Earth (remote sensing) and the use of an unmanned aerial vehicle. Comparison of satellite images, aerial photographs and a geographical map on a single scale makes it possible to analyze the history of changes in the riverbed in the plan and identify areas of the river with intensive manifestation of riverbed processes.

In the course of the assignment for designing of objects and constructions of engineering protection from flooding by flood waters of the territories of inhabited localities, was carried out at the hydrometeorological survey of the river Khilok in areas village Mogzon and the village Hahotou made aerial drone quadcopter Phantom 4 Pro, analyzed stock and cartographic materials.

The Khilok river originates from lake Shakshinskoye, flows through the wide inter-mountain valleys of the territory of the TRANS-Baikal territory and the Republic of Buryatia mainly in the South-West direction and flows into the Selenga river on the right Bank 242 km above its mouth. The length of the watercourse is 840 kilometers. The main feature of the climate is the large amplitude of fluctuations in average daily and seasonal air temperatures, its significant dryness, relatively small amount of precipitation in winter, a sharp change of seasons, and the predominance of rainwater runoff over spring flood runoff. The bottom of the intermountain basins through which the river flows is located at altitudes of 500-800 m.The river valley has a box-like shape with a width of 2-4 km along the bottom. The slopes are composed of crystalline rocks, covered with sand and loam on top, and overgrown with coniferous forest. The floodplain is two-sided, mostly 1.5-2 km wide. in the studied areas of settlements, the banks are low, flat, sandy and pebbly, covered with bushes, and are flooded during floods.

During the expedition survey of the riverbed in the area of the village of Hahotou and the village of Mogzon, the types of riverbed process were determined: free meandering, incomplete meandering and floodplain multi-armedness. Analysis of cartographic material from 1980, satellite images and aerial photographs taken in December 2019, showed the presence of horizontal deformations of the riverbed, which is expressed in the displacement of bends along the length of the river, the development of straightening channels and the death of old arms.

Also, when calculating the flood of 1% security, settlements are in the zone of flooding. Therefore, in order to avoid negative consequences, it is necessary to carry out engineering protection of territories by adding soil or building dams of collapse, taking into account the geomorphology of the riverbed and the speed of the river flow.

SESSION 5 «THE ROLE OF GEOGRAPHICAL EDUCATION AND EDUCATIONAL FUNCTIONS OF ENVIRONMENT IN THE MODERN CONCEPTS OF SUSTAINABLE DEVELOPMENT»

EDUCATIONAL POTENTIAL OF LANDSCAPE-RECREATIONAL RESOURCES OF COASTAL AREAS OF LAKE BAIKAL

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Problem statement. Recently, the problem of anthropogenic transformation of picturesque landscape complexes of the Lake Baikal coast stands out due to the low level of ecological culture of vacationers. The objective is to assess the educational (outreach) value of landscapes in solving environmental problems that arise during due to tourist activities. The study area is the coast of Lake Baikal near the Bolshoe Goloustnoe village (Goloustnoe coast), which is recreationally attractive for the population of the nearby Irkutsk city agglomeration.

Materials and methods. The educational potential of landscapes was analyzed using the map of the modern landscape structure of the Goloustnoe coast (1: 100 000). It was compiled based on topographic maps of different times, fieldwork materials, and also remote sensing data. Aerial photography was performed using an unmanned aerial vehicle DJI Mavic 2 Pro with a Hasselblad L1D-20c camera. The analysis of the obtained images helped to identify foci of adverse processes caused by anthropogenic influence and contributed to the calculation of the area of recreationally transformed complexes.

Key research insights. Within the relatively small limits of the Goloustnoe coast, contrasting mountain taiga dark coniferous and light coniferous, subtaiga light coniferous and piedmont steppe geoms adjacent to the lake, developed, which causes natural uniqueness and tourist attractiveness. The greatest preference of tourists is given here to active types of recreation, as Goloustnoe coast is suitable for both one-day trip and a long-term visit.

An unorganized and uncontrolled flow of tourists causes is the source of concern for transformation of landscape complexes, which are unique, aesthetically attractive, but not very resistant to anthropogenic loads. The main environmental problems here are littering the territory in combination with the problems of storage and removal of solid household waste, trampling and driving off-road, the chaotic organization of picnic leisure with bonfires, which increases the risk of fires and the lack of environmental morality.

Taking into account the recreational potential of landscapes adjacent to the water area of Lake Baikal as a UNESCO World Heritage Site, the orientation of nature management towards the development of an ecotourism is important for damage control. Within the framework of the sustainable development of the Goloustnoe coast, the exploitation of the educational (enlightening) resource of the natural environment is promising for increasing knowledge about the specifics of natural conditions, as well as for the formation of environmental awareness and environmental responsibility. Organization of walking routes along equipped ecological paths, considered as one of the main areas of ecotourism, helps to obtain natural and ecological knowledge.

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THE APPLICABILITY OF URBAN PLANNING TECHNIQUES FOR ENVIRONMENTAL PROTECTION OF THE 1980S IN MODERN CONDITIONS

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At this moment the strategic purpose in the field of spatial organization is the sustainable development of cities for the long term. This provides not only the conditions for economic growth, but also the creation of favorable conditions, maintaining the quality of the environment for future generations. Accordingly, a separate task is to identify territories that should be preserved and reserved for environmental and recreational functions, with any options for the development of the city.

Sustainable development is a common idea designed to unite all people in a movement to preserve the nature of the Earth and man himself. Ecologization of all areas of human activity, eco-restoration, eco-reconstruction of nature and artificial environment can be called modern priorities for sustainable urban development.

In our country in the post-revolutionary years a system of scientific and design work on urban development developed and spread, and it represented a hierarchically organized set of design and planning documentation covering a wide range of territorial objects (from a residential microdistrict to the country as a whole). The methodology of territorial planning that was developed in the 80s by urban planning institutes which includes the allocation of large areas of conservation of ecological potential, the creation of counterweights to settlement systems in the form of vast natural spaces and the formation of an ecological framework, determining the marginal parameters for the development of areas, calculating the demographic capacity, and calculating the ecological capacity of territories with high population density. This methodology meets the ideas and priorities of sustainable development, but is not applied for various reasons in the practice of territorial planning.

STUDENT INITIATIVES AND PERSONAL SELF-REALIZATION IN PROFESSIONAL GEOGRAPHICAL EDUCATION

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The integration of the world and Russian educational space is based and implemented in the process of educating a person with an active lifestyle that can work with large and small social groups of different ages, sex, health, racial and religious affiliations. This is the combination or interweaving of the global humanistic ideology with the state policy of Russia in the field of modernization of education. Modern domestic higher pedagogical education is trying to solve three groups of systemic problems that have a significant impact on the implementation of the principles and directions of the organization of the educational process: the fundamental nature of theoretical knowledge, practical skills adequate to public demand and the development of a harmonious personality.

The strategic vector of the direction of development of education is the acquisition of practical competencies. In our opinion, this goal can only be achieved by combining the areas of professional training and integrating student initiatives in a single educational field.

In the process of studying at a university, educational and professional activity becomes an important part of student's self-expression. The student in the learning process realizes his cognitive needs through learning activities. Therefore, the self-realization of a person in a university is very relevant, since without it it's impossible to implement the principles of a competency-based paradigm (a student will not be able to form competence without manifesting his own activity, including in the cognitive sphere). A series of works has been devoted to the phenomenon of self-realization of a student's personality at a university (Tsurikova, 2008; Baryshnikova, 2002; Chukhin, 2010). Through self-realization and cognitive needs, the student develops and acquires new knowledge, skills and realizes himself in the future.

The most suitable direction for the implementation of this approach is extracurricular work, the purpose of which is to support student initiatives, to promote the creation of an optimal socio-pedagogical educational environment aimed at creative self-development and self-realization of students by organizing work on their active inclusion in the main forms of university activity.

Types of extracurricular activities implemented at the Department of Geography, Life Safety and Methodology:

- Organization of research work of students;
- Work on vocational guidance and assistance in employing students;
- Assistance in obtaining additional education in the general direction of vocational training;
- Organization of work of the youth club of the Russian Geographical Society "Portulan" and the student rescue squad "BARS";
- Educational work, which includes the work of curators, military-patriotic education, education of social responsibility, etc.

In our work, we rely on the desire of youth to self-realization of a person in vocational education and in the surrounding social space. Therefore, the task of higher pedagogical education, at the present stage, is to teach students methods of action that allow them to study productively, realize their educational needs, cognitive interests and future professional challenges. Support for student initiatives and the active inclusion of students in a wide range of university activities contribute to the creation of an optimal socio-pedagogical educational environment aimed at creative self-development and self-realization of students' personalities and determine the purpose and tasks of extracurricular work in the system of higher professional education.

FEATURES OF GEOSYSTEM AND ECOSYSTEM APPROACHES IN ECOLOGICAL EDUCATION

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Environmental education can develop in two directions: education in the spirit of the general ideas of nature conservation, respect for it (environmental education) and the acquisition of professional specialized knowledge about the general laws of the existence of natural and anthropogenic ecosystems (environmental education as such). The first direction is aimed at mastering the general ecological culture by specialists of various fields. The second direction is intended to ensure the training of highly qualified specialists in the environmental field, capable of solving various problems in the field of ecology, rational nature management, environmental protection and environmental education in any industry within the framework of existing environmental legislation.

Traditionally, in teaching ecology, an ecosystem approach is used, in which the main link when considering an ecosystem is the biota or man. The abiotic component plays only the role of a habitat that organizes the conditions for the existence of biota, which involuntarily leads to an anthropocentric view of the relationship in the "man-nature" system.

The geosystem approach allows you to study a natural system step by step, starting with considering each of its components separately (water, air, vegetation, etc.), and ending with modeling the dynamics and evolution of the entire geosystem as a whole. This approach emphasizes the equivalence and continuity of the identified components of the geosystem, due to the processes of its evolutionary formation, and forms a holistic ecocentric view of nature (Lesnykh, Korolkova, 2019).

In environmental education, despite the existing system and teaching methodology, it is advisable to use various approaches, the choice of which should be determined by the tasks. If we are talking about the training of environmentally oriented specialists in various fields of knowledge (lawyers, programmers, accountants, etc.), then the application of the ecosystem approach will be sufficient. If we are talking about the training of highly qualified environmental specialists, on whom the accuracy, legality and validity of decision-making in the field of ecology and environmental policy depend, then it is necessary to introduce a geosystem approach at the earliest possible stage of environmental education of future specialists.

The approbation of the implementation of the geosystem approach in the environmental education of schoolchildren was carried out as an extracurricular activity within the framework of the Baikal Summer School. The camp was located on the shore of Lake Baikal, within the boundaries of the tourist and recreational zone, located near the village of Bolshoye Goloustnoye, Irkutsk Region. This part of the western Baikal region is characterized by a unique combination of geosystems of different types: mountainous, submontane, steppe, riverbed, and aquatic. Thus, by studying the area, young researchers were able to capture a wide range of natural components that make up geosystems and trace their interrelationships.

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PROFESSIONAL AND PEDAGOGICAL TRAINING OF FUTURE GEOGRAPHIC TEACHERS

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The result of the educational process is formed by the quality of training of a graduate who meets the requirements of modern society and the labor market. The priority direction in the formation of the personality of the future teacher is his spiritual and moral training. The Federal State Educational Standard of Higher Education in the direction of "Pedagogical Education" (with two training profiles) regulates the requirements for the level of preparation of bachelors through the formation of competencies. The formation of general professional competence provides for the ability of students to participate in the development of basic and additional educational programs, the ability to develop their individual components. Professional competence determines the ability to master and use basic scientific and theoretical knowledge and practical skills in professional activities. Vocational training carried out in the framework of educational and extracurricular, educational activities allows to create a productive educational environment, on which the result of the educational process largely depends.

Bachelors are prepared in accordance with the requirements and profiles "Life Safety - Geography", "Biology - Geography" at the Pedagogical Institute of Irkutsk State University. This preparation also includes the involvement of students in the system of extracurricular activities of the university. At the Department of Geography, Life Safety and Methodology, PI ISU, educational and extracurricular work on geography is carried out in several areas.

This is participation in the organization and holding of the annual Interregional Olympiad for schoolchildren of 8-11 grades named "Geographic Olympus", the All-Russian scientific-practical conference with international participation named "Baikal-Rodina-Planeta", the preparation of students for the regional stage of the All-Russian Olympiad of geography - "Winter School".

The youth club of the Russian Geographical Society "Portulan" operates on the basis of the department. Since 2016, employees of the department and students have been conducting a city interactive local history team game "Following the Sun" for students in grades 9-11. Master classes are held for students, where students can get acquainted with the experience of leading geography teachers of the schools in Irkutsk. The department organizes an educational and methodological seminar "Practice of the Second Generation of the Federal State Educational Standard", in which teachers of the schools of the city and Irkutsk region also take part.

The third area is associated with the participation of schoolchildren in city and regional scientific and practical conferences. Senior students and undergraduates studying in the fields of "Geographical Education" and "Integrated Safety of Educational Organizations" act as experts on sectional sites: "Step into the Future, Siberia!" , "Eureka", "Geoparks in the Baikal Region", urban environmental research contest "Paths of the Baikal Region". The fourth direction of extra-curricular activities in the sphere of geography is carried out in accordance with the cooperation agreement with Municipal government institution of the city of Irkutsk "Information and Methodological Center for the Development of Education". The main provisions of joint activities are determined by the need to improve the scientific, methodological and career guidance work in order to form the students' desire for continuous improvement and professional self-determination, the formation of skills and abilities to build their own educational space. As well as the development of innovation, improving the educational process, developing and testing effective forms and methods of educational activity, focused on the development of the personality of the student, the disclosure of his creative potential. Students and teachers of the department participate in organizing and conducting events of the city intellectual-cognitive marathon "Constellations of Lake Baikal." Practice-oriented seminars on the basis of pilot schools provide an opportunity for future teachers to get acquainted with the experience of organizing the educational activities for the school, to study in detail the features of the use of various pedagogical technologies in the subject preparation of students.

Thus, diverse extracurricular work allows to master and use basic scientific and theoretical knowledge and practical skills in professional activities, and also counts as one of the means of control of the quality of education.

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