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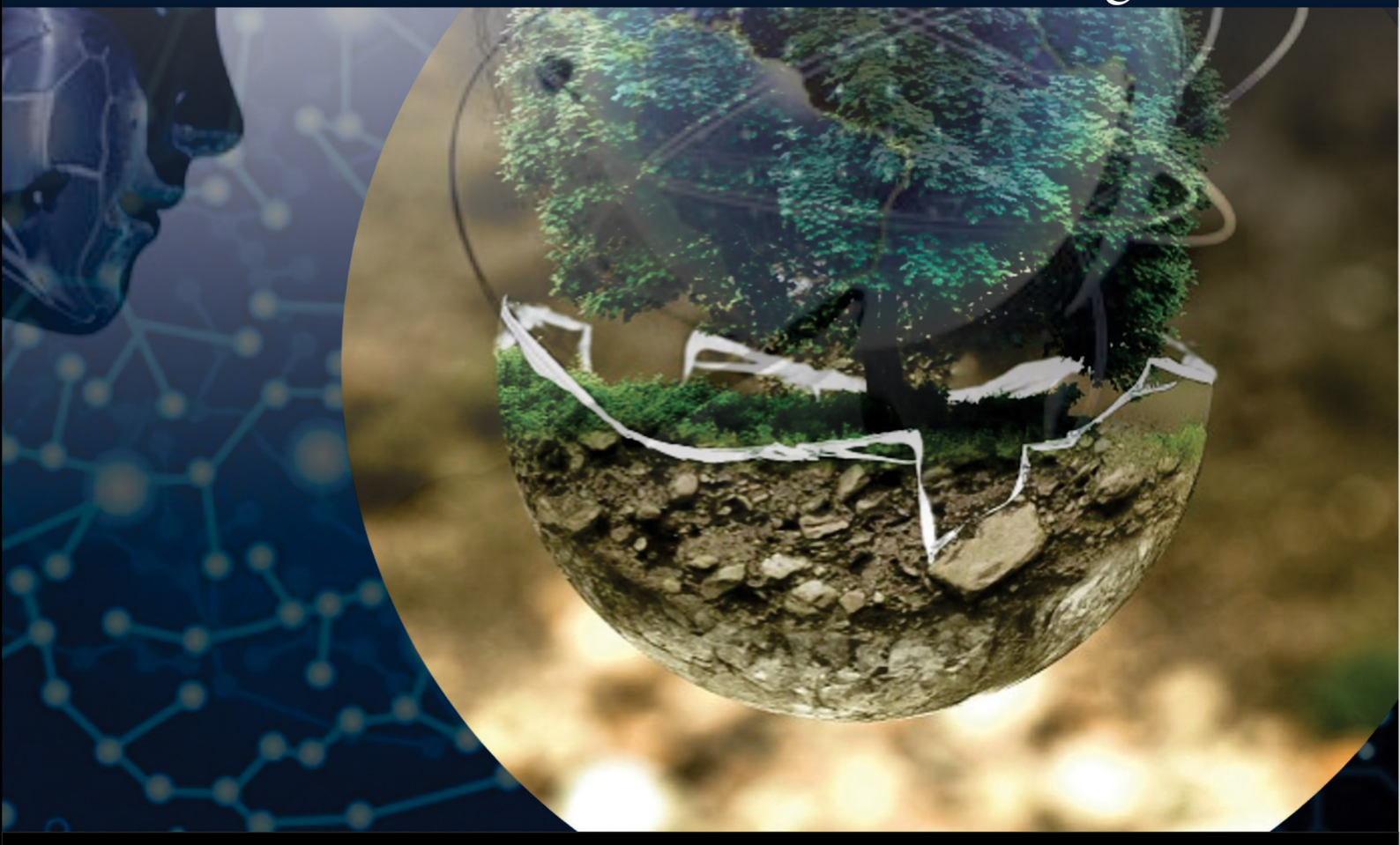

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TABLE OF CONTENTS

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CLIMATE CHANGE IN THE ESTIMATES OF THE POPULATION IN THE HIGH-MOUNTAIN REGIONS OF RUSSIA

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Abstract - The high-mountain areas of Russia including areas of the Altai Republic are characterized by intense climate change, the consequences of which in the long term will have a tangible impact on their socio-economic development, the level of security and well-being of the population. The article presents the results of sociological surveys of the population in six settlements of Kosh-Agachsky and Ulagansky districts of the Altai Republic, located near the centers of dangerous exogenous processes (n = 163), which allowed to describe the perception of climate threats and to articulate the risks that are of greater concern to residents and affect the preservation of their traditional way of life and ways of doing business.

Keywords - climate change, glacier melting, high altitude areas, perception of climate risks, risky natural environment

The fight against climate change and its consequences is one of the important priorities of national security for the Russian Federation and a condition for sustainable socio-economic development, which is reflected in the Climate Doctrine of Russia and other strategic documents (National Security Strategy, Spatial Development Strategy, etc.). Adaptation of the population and the economy to climate risks, development and implementation of technological innovations to reduce the burden and effectively eliminate the effects of anthropogenic impact on nature and improve the quality of life of citizens, are important tasks that will have to be solved in the near future. An effective policy in this area requires a comprehensive approach that takes into account the high level of uncertainty and the difficulty of predicting climate change, and combines both restrictive, protective, and stimulating measures to accelerate economic growth through the use of the best available technologies [Porfiryev 2019].

Russia is actively involved in global climate processes, but their effects are highly differentiated by region. Along with the Arctic zone, the high altitude territories of the Altai-Sayan mountainous country, which are characterized by a large spatial variability of climatic characteristics and a variety of ethnocultural landscapes with a high degree of environmental, attract special attention of scientists [Analysis and forecast of climate change 2018 ;Dirin 2020]. Previous studies have shown that climate has a direct impact on the safety of the population of a given region, primarily due to the high risks of dangerous hydrometeorological events (floods, droughts, avalanches, landslides, etc.), which cause potentially higher level of risks to the life and health of citizens, and significant dependence of the region's economy on the state of the ecological system [Assessment Report 2011]. Global warming is more intense here, assessment of the temperature dynamics indicates an increase in air temperature (by an average of 3°C over the last 60 years) that exceeds the climatic norm, glaciers are especially affected, the area of which has decreased by 25% over the last 50 years, and the rate of melting has more than doubled only for 2008-2017 [Toropov, Aleshina, Nosenko, Khromova, Nikitin 2020]. At the same time, the warming trend is accompanied by fluctuations and cooling in the last decade, as well as the absence of significant changes in the precipitation regime, which indicates the aridization of the territory [Sukhova, Zhuravleva, 2017]. The state of scientific research in the field of climate is characterized by a significant bias towards the study of natural scientific foundations, while the social and cultural aspects of the life of the population in the difficult conditions of high altitude risky natural environment remain understudied. Meanwhile, the development of mechanisms for effective adaptation of the population to climate change, predictive models that reflect the interdependence and mutual influence of climate change, politics and people's behavior is impossible without a deep analysis of subjective assessments, social perceptions and attitudes of citizens regarding climate.

II. RESEARCH METHODS

Within the framework of an interdisciplinary research project focused on climate, landscape, and glacier changesin Altai, implemented by research teams of St. Petersburg and Altai State Universities, a sociological study was conducted to estimate the climate change and to study adaptive strategies of the population in a risky natural environment including features oftransformation of territorial nature resource management systems in the inner-continental mountain regions. Empirical data were collected in six settlements of the Kosh-Agach and

Ulagandistricts of the Altai Republic: Kosh-Agach (the administrative center of the Kosh-Agach district), Novy Beltir, Kurai, Kyzyl-Tash, Aktash, and Chagan-Uzun. The total sample consists of 163 people aged from 22 to 80 years (61% of the respondents were women, 39% were men). In parallel with the surveys, in-depth interviews, conversations and participant observation were conducted, which allowed the quantitative data tobe supplemented with "qualitative" sociological material, describing local characteristics and ethno-cultural aspects of economic activity.

III. RESULTS AND DISCUSSIONS

The results of the surveys showed that the population of high-altitudeareas perceived climate change as significant, although they assessed it rather inconsistently, mixed with assessments of general climatic conditions, seasonal and cyclical temperature fluctuations. Residents found it difficult to track long-term trends in conditions of abrupt temperature fluctuations; they often described climate change in terms of weather typical for the season or the nearest years.

Public opinion diverges significantly from general statements about global warming and partially corresponds to actual meteorological changes in some parts of the region. In particular, almost half of the respondentsin the six settlements (49.1%) noted that, according to their feelings, over the past few years, the average annual temperature has become lower, about 20.0% indicated an increase in temperature, and almost the same number (22.7%) did not notice any changes. An analysis of respondents' answers depending on the place of residence showed that the responses of Kurai and Kyzyl-Tash residents (71.4%) indicated the temperature decrease more often, while in Kosh-Agach similar estimates were only 46.4%. The opinion about the increase in the average annual temperature was more typical for Kosh-Agach (25.0% of responses, in other settlements not higher than 19.6%), but these differences were not statistically significant.

Along with the assessment of changes in average annual temperatures, climatic changes by seasons were studied separately. Regarding winter temperatures, residents noted that winters have become colder over the past ten years (64.6%), especially in the villages of Kyzyl-Tash and Kurai, where 90.9% of respondents gave this answer. Only 15.2% of survey participants reported warming winters, for 19.6% of people winters have not changed. Indeed, climatologists record a slowdown in the growth of winter temperatures, especially in January, which in the last decade (according to data for 2007-2016) is characterized by a decrease in the average monthly temperature below the climatic norm (1961-1990) [Analysis and forecast of climate change 2018, p. 19]. In addition to temperature changes, more than 67% of respondents indicated an increase in prolonged frosts, periods of abnormal cold, 55.9% of respondentsnoted increased wind, blizzards and snow drifts, 50.9% of people indicated sharp temperature changes (from cold to warm and vice versa). Despite the fact that the latest data show trends towards aridization of the climate, almost 40% of the study participants noted an increase in heavy snowfalls and, in general, an increase in snow cover, 35.4% experienced discomfort from cloudy weather and a decrease in winter insolation.

According to the overwhelming majority of residents of six settlements (71.3% of valid answers, among residents of Kuray and Kyzyl-Tash - 82.6%), the temperature decreased not only in the winter, but also in the summer months. Warming was noted only by 13.4% of respondents (the maximum share of answers - in Kosh-Agach, 20.3%), no significant changes by 15.3% (maximum - in NovyBeltir, 25.9%). Residents also noted an increase in the number of dangerous meteorological phenomena in the summer, especially strong winds, storms (59.9% of responses, in the group of Aktash - Chagan-Uzun - Chibitsettlements: 66%). Almost a third of the respondents (28.7%) pointed to the increase in periods of abnormal heat (especially in NovyBeltir - 40.7%), 52.2% indicated an increase in the number of dry days, without precipitation (in NovyBeltir - 63.0%). At the same time, a significant number of respondents (47.1%) noted that there was more precipitation in summer, and the rains became stronger and longer (47.1% of the answers in total, at least 34.8% in Kurai and Kyzyl-Tash, maximum of 56.9%in Aktash, Chibit and Chagan-Uzun). About a fifth of the respondents also pointed to increased flooding, river overflows, flooding of places that had not been flooded before, the same number pointed to permafrost melting, groundwater coming to the surface, 12.7% pointed to an increase in rockfalls and landslides in the mountains, which was a marker of specific changes associated with glaciers and climate change in the permafrost zone. In Kosh-Agach, the problem of underground ice melting was noted by almost a third (28.6%) of the residents who took part in the survey. In addition to the climate risks themselves, residents pointed to the growth of indirect risks arising under their influence. For example, almost every fifth inhabitant of the mountainous regions noted an increase in the number of insect pests that threaten agricultural crops and coniferous forests.

The study focused on the problems of social security associated with the transformation of glaciers and landscapes of high mountains and considered primarily in the context of changes in the way of life and economic activity of people under the influence of climate change associated with glacial phenomena.

Residents certainly notice that the glaciers are changing. In personal conversations and in-depth interviews, they described changes in the appearance of glaciers (the typical answer is “you come and see that the glacier cap has become smaller”) and the disappearance of water sources in the pasture and camp areas, which are very important to them because income and opportunities for survival in harsh climate conditions are mainly formed by cattle breeding. However, these changes are not perceived as catastrophic, they are very slow changes, the consequences of which come gradually and are accepted as the natural course of things. Opinions of residents were divided: 58% of respondents believed that living near glaciers does not pose a serious danger, while 42% held the opposite view. At the same time, there was a significant variability in responses depending on the settlements of the survey. Thus, in NovyBeltirvillage, where residents suffered from a strong earthquake in 2003, only 29.6% of residents noted the risks of living near glaciers, while in Kosh-Agach the share of such answers reached 48.3%. Further, in the group of those who believed that it was dangerous to live near glaciers, it was specified what kind of risks are associated with changes in the ice mass and the natural phenomena. It is possible to highlight the most important points that were noted by many residents. First of all, these are high risk of livestock loss due to cold, lack of fodder and other reasons (67.2% of responses), risks associated with the difficulties of conducting agricultural activities (plants grow poorly, it is difficult to cultivate the land - 50.0%), drought, drying up of rivers, lakes, fires (43.8%) and destruction of houses, buildings, engineering structures due to thawing of permafrost (35.9%).

IV. CONCLUSIONS

Thus, the analysis of residents' opinions revealed the high relevance of climate change issues for the high-altitude regions of Altai Mountains and their close relationship with the socio-economic indicators of the development of these territories. So far, climate change has not formed the current agenda, but is perceived as an addition to the traditional problems of survival in a sharply continental climate and permafrost with low temperatures, scarce precipitation, and infertile soil. Meanwhile, the consequences of these changes lead to new risks that add up to long-term economic problems that have been exacerbated since the 1990s and are still unresolved. It is obvious that climate challenges will worsen, which requires a deeper study of the attitudes and behavior of residents in relation to the perceptions and strategies of decision-makers in this area. Modeling of these processes, taking into account the natural science component, allowing to combine subjective assessments of the region’s residents and objective scientific data, is the priority task for the next stage of the study.

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