International monitoring of permafrost

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Abstract. The international community has taken upon itself the responsibility for the condition of the environment as a human habitat. International conventions draw attention of governments to the pollution and deterioration of the environment as a result of economic and other human activity. Particular attention is paid to issues of climate change and sustainable development, emissions of greenhouse gases into the atmosphere are taken under government control. According to research data, at the present stage there is an onset of a thawing process of not just Arctic ice, but also of permafrost. The thawing of permafrost on one hand is a result of climate warming, on the other hand it will inevitably lead to emission of greenhouse gases into the atmosphere and become a source (cause) of climate change. Permafrost covers the territories of northern parts of America, Europe, Asia, islands of the Arctic Ocean, and the Antarctica. The paper argues for the necessity of research on the thermokarst processes on the basis of international cooperation, the development of an international permafrost monitoring network. Establishing the principles of organization of international cooperation, the funding and the creation of a permafrost monitoring network in international agreements will become another step towards ensuring the environmental security of our planet. Research and reproduction of scientific knowledge were conducted along the spectrum of related fields of international and environmental law and areas of legal regulation, and also at the crossing of law and fields of permafrost studies, geology, ecology, biology, environmental protection.

1 Introduction

Pollution and deterioration of the environment as a result of human impact, economic activity in particular, is becoming a global problem. According to Drengson Alan R., “the number of toxic chemicals in use globally is equal to 600 000, with around 3 000 added annually. There are approximately 145 million tons of sulfur dioxide, 250 million tons of dust, 70 million cubic meters of gas, about 1 million tons of lead compounds, tens of thousands of fluoride and chloride compounds being emitted into the atmosphere per year” [1, 2]. According to monitoring data of the Intergovernmental Panel on Climate Change for the area of 60-90 degrees North latitude temperature increase in the last 20 years amounts to 1.2°C/20 years [3]. Since the 1980s the temperature during cold seasons in most parts of the Arctic belt has increased by approximately 1°C per decade [4].

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According to some scientists, economic activity of humans is the cause of climate change [5, 6], but there are also opponents of that hypothesis [7, 8, 9]. For example, V.A. Vladimirov proposes a following four-group classification of all specialists related to the subject:

1) uncompromising proponents of economic human activity as the primary cause of global warming;
2) those who accept global warming as a fact, yet consider its mostly anthropogenic origin difficult to prove;
3) those who doubt the validity of global warming as a fact;
4) supporters of the argument that in the coming decades the climate will cool instead of warming [10].

At the present stage the scientific research in the past decades points to the idea of global climate change without arguing for its warming or cooling. Is global climate change connected to human activity? According to A.V. Vladimirov and Y.I. Churakov, “it is most likely that the current climate change is a result of both natural causes and human activity, but the question whether these causes correlate with each other and which of them is the primary cause, is the subject of complicated research” [10]. Climate change toward one way or the other will have an effect on the quality of human life. That is why ensuring ecological security becomes crucial to the global community. American ecologist L. Brown points out that the 1970s were marked by a series of national laws related to environmental issues, and that the coming decades may well be marked by similar efforts internationally [2, 11].

According to A.V. Kukushkina “Ecological security, included initially as one of the elements of a comprehensive international security system, gradually becomes one of the most important parts of that system” [2]. By joining international agreements and conventions, states express their consent to be bound by the treaty (Convention on the Law of Treaties, 1969), i.e. accept the responsibility to undertake measures of implementation of its norms into national legislation.

As was pointed out by a number of researchers “while the world continues its work on understanding and forecasting the consequences of climate change, the Arctic … is the most important component, acting as an indicator region” [12]. The latest environmental monitoring data, particularly the data acquired by analyzing and comparing satellite images, shows the beginning melting process of the Arctic ice [4, 13, 14], which could lead to sea level rise and deterioration of permafrost [15]. According to researchers “permafrost is an important piece in the climate change puzzle” [12]. The thawing of permafrost on one hand is a result of climate warming, on the other hand it will inevitably lead to emission of greenhouse gases into the atmosphere and become a source (cause) of climate change.

2 Objective

This research provides the basis for the necessity of the adoption of international agreements on permafrost monitoring, which will become the foundation of legal regulation of organizing an international monitoring network, data exchange, international cooperation and collaborative comprehensive research of geological processes in the cryolithozone, in order to predict the effect of permafrost deterioration on the environment.

3 Materials and methods

During the research the following methods and approaches were used: the general scientific and the special legal methods (legal doctrines developed by researchers of general legal theory and environmental law, legal dogmatics, means and methods of legal technique that allow to work with legal acts, navigate the principles and institutions of law, ways and
methods of interpreting laws and legal practice). Research and reproduction of scientific knowledge were conducted along the spectrum of related fields of international and environmental law and areas of legal regulation, and also at the crossing of law and fields of ecology, biology, geology, environmental protection.

4 Results

For the first time on the international level protection of the environment was discussed at the United Nations Conference on the Human Environment held in Stockholm in 1972, which resulted in the adoption of the Declaration of the United Nations Conference on the Human Environment (Stockholm, 5-16 June, 1972). This declaration resulted in the human right to a healthy environment being acknowledged in international law. Subsequently, basic principles established in the Declaration of 1972 gave a push towards the development of ecological law in many countries, including Russia. In 1992 the Rio Declaration on Environment and Development was adopted (the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992). The Declaration of 1992 also served as a foundation for the expansion of ecological rights – the right to accurate information on the environment, compensation of damage inflicted by an environmental offence, responsibility of states to the global community, and other important legal stipulations.

On the international level climate change was discussed in 1992, which resulted in the adoption of the United Nations Framework Convention on Climate Change (New York, May 9th 1992). The Framework Convention on Climate Change establishes a unified conceptual framework, as such the term “greenhouse gases” is defined as “gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and re-emit infrared radiation”. The Framework Convention of 1992 was later expanded by the Paris Agreement of 2015 (the final document of the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC)). Furthermore, regarding the global community’s concern in preserving ecological security it is necessary to mention the United Nations General Assembly Resolution of September 25th 2015 “Transforming our world: the 2030 Agenda for Sustainable Development”.

In Russia the following federal laws were enacted – Federal Law №296-FZ of 02/07/2021 “On the restriction of emissions of greenhouse gases”, Federal Law №34-FZ of 06/03/2022 “On the experiment of emission restriction in certain regions of the Russian Federation”, Decree of the Government of the Russian Federation №2979-r of 22/10/2022 established a list of greenhouse gases subjected to state emission monitoring and emission inventory, etc. The list of greenhouse gases subjected to state emission monitoring and emission inventory in Russia includes 33 greenhouse gases, including 19 hydrofluorocarbons (HFCs) and 9 perfluorocarbons (PFCs).

So, international agreements play a significant part in the development of national legislation of states, the sources of environmental law in particular. Positive experience of legal regulation of environmental protection and environmental security of foreign countries is adopted and implemented into national legislation. Lately questions on the role of human economic activity in climate change are disputed, scientists in many countries conduct research on the current state of the environment, compare data from the past decades, determine causes, make forecasts, do not ignore the condition of cryolithozone. Combined area of the cryolithozone on the planet reaches 35 million m² (no less than 25% of the planet’s total land area) [16] and covers the territories of northern parts of America, Europe, Asia, islands of the Arctic Ocean, and the Antarctica. It is most widespread on the territories of Russia, Canada, and China [17, 18]. In Russia permafrost covers 60-65% of the
territory and is common in its arctic and subarctic areas [19]. Thawing of permafrost may become one of the ecological problems stemming from climate change [15].

Permafrost as a reservoir of preserved carbon in vast frozen peat bogs in the northern territories of Eurasia and North America, in a warming climate may become a source of an even greater warming due to release of greenhouse gases [15]. Carbon dioxide and methane are among the most potent greenhouse gases [20, 21]. The thawing of permafrost results in the formation of thermokarst lakes with small areas of 0.05-0.1 hectares [15]. In Yakutia ecosystems with these small lakes are called “alas”, area increase of thermokarst basins is a result of thawing ice and will lead to increase in production and release of methane into the atmosphere in large quantities [22]. In order to study the dynamics of thermokarst processes and further permafrost monitoring it is necessary to compile geocryological maps, chart the distribution of lakes in the permafrost area [23], etc.

In current scientific literature the following terminology is accepted: “cryolithozone” and “permafrost” (in permafrost studies), “permafrost rock mass” (in geology), “permafrost soil” (in soil science), “permafrost ground” (in urban planning) and is defined as a part of lithosphere characterized by lack of periodical thawing, presence of frozen materials. Some works use the term “ever-frost” [12], which the author finds to be inexact and inconsistent with the current scientific approach.

The beginning of permafrost studies in Russia is attributed to the foundation of a permafrost research station at the Permafrost Studies Institute of the Academy of Sciences of the USSR in Yakutsk in 1941. Great input into the study of permafrost is contributed by researchers of the Institute of Biological Problems of Cryolithozone of the Siberian Branch of the Russian Academy of Sciences, North-Eastern Federal University, and other research and education facilities of Russia.

Presently in Russia first steps are being taken in the field of legal regulation concerning permafrost monitoring on the state level. For example, Federal Law №297-FZ of 10/07/2023 introduces additions to the conceptual framework of Federal Law №7-FZ of 10/01/2002 “On the protection of the environment”, hydrometeorological services of Russia are tasked with conducting state background permafrost monitoring. Conceptual framework of environmental law is expanded with legal definitions of the terms “soil”, “permafrost soil”, “condition of permafrost”, “deterioration of permafrost soil”, “state background permafrost monitoring”, i.e. permafrost is considered as a permanently frozen soil, soil (surface layer of the ground consisting of mineral and (or) organic matter) that exists in cryogenic state for more than three years. Thus, lawmakers take into account one aspect of permafrost: the soil as the basis (foundation) for human economic activity. In my opinion, permafrost monitoring must cover all processes of the cryolithozone: physical and chemical condition of permafrost, its effect on the components of natural environment, existing cryogenic ecosystems, the environment. Such data will allow to determine and assess on one hand the effect of human activity on the condition of permafrost, on the other hand, what consequences to expect with its thawing.

As fairly mentioned by A.V. Kukushkina “Ecological security, included initially as one of the elements of a comprehensive international security system, gradually becomes one of the most important parts of that system” [2]. Specifically, scientific cooperation is a popular topic, although in real practice it entails a variety of problems and counterproductive difficulties [12]. Researchers name “lack of collaborative research, especially data research” as one of the greater difficulties, which “significantly decreases the efficacy of overall understanding of permafrost”. While it is impossible for one country to effectively conduct a variety of simulations and research necessary to fully understand the impact on permafrost, the global community is able to do so [12]. Bouffard T.J., Uryupova E., Dodds K., Romanovsky V.E., Bennett A.P., Streletsiky D. propose in their paper a concept of a global
permafrost monitoring system working in real time [12]. Establishment of such a system requires legal framework.

5 Discussion

Adoption of a universal convention on permafrost monitoring would become another additional step of the global community toward ensuring ecological security and sustainable development. This document must establish basic principles of international cooperation of states, unified conceptual framework, mechanisms of international scientific cooperation and data exchange, funding of research and organizing of international permafrost monitoring network.

In my opinion, such monitoring must be based on the following principles:

- The duty of states to conduct political and economic activity in a way that ensures conservation and maintains an adequate condition of permafrost;
- Economic and other activities must be conducted in a way that allows undertaking of preventive measures in order to prognosticate, prevent or minimize the causes of the thawing of permafrost and mitigate its negative impact on the environment;
- Scientific and technical cooperation in order to contribute to the functioning of the international permafrost monitoring network and research;
- Validity of the selection of methods and approaches to the monitoring of permafrost, free movement of data on its condition and changes.

International monitoring network must be accountable to international intergovernmental organizations, the study of processes in the cryolithozone must be conducted by research facilities. Such studies must involve experts from various fields of science: permafrost studies, geology, geocryology, hydrology, geohydrology, geophysics, ecology, biology, botany, forest science, zoology, plant and animal physiology, cartography, geographic information systems (GIS specialists), etc.

Schematically the main concepts of international cooperation in the field of permafrost monitoring are formulated and presented in the table 1.

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Funding of the international permafrost monitoring network and scientific research

Establishment of an international permafrost monitoring network

Selection of unified methods of monitoring and processing of data

Movement of data on the condition of permafrost, prognosticating

Scientific and technical equipment

International scientific cooperation in the field of permafrost monitoring

Validity and unity of methods and approaches of research

Free movement of research results for purposes of processing and generalization, development of proposals on the decrease of anthropogenic load

Transparency and accessibility of information, data on acquired results

Development of proposals on the decrease of anthropogenic load on permafrost territories (cryolithozone)

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