FEDERAL SCIENCE AND TECHNOLOGY PROGRAMME OF THE RUSSIAN FEDERATION IN THE AREAS OF ENVIRONMENTAL IMPROVEMENT AND CLIMATE CHANGE FOR 2021-2030

BLUEPRINT

Approved by the Presidium of the Presidential Council for Science and Education

Under Decree No. 76 of the President of the Russian Federation of 8 February 2021 “On measures for the implementation of the state science and technology policy of the Russian Federation in the areas of environmental improvement and climate change” the Government of the Russian Federation is instructed to ensure the development and approval of the Federal Science and Technology Programme of the Russian Federation in the areas of environmental improvement and climate change for 2021-2030 (hereafter FSTP).

Leading Russian experts in the field of climate change and environmental science have participated in the development of the FSTP. Among them are distinguished scientists such as Prof. Sergey Gulev, Dr. Vladimir Kattsov, Prof. Boris Porfiriev and Dr. Anna Romanovskaya.

FSTP provides an expert description of the current state of research and development in the Russian Federation in the areas of environmental improvement and climate change. The Strategy of Science and Technology Development of the Russian Federation, approved by the Decree No. 642 of the President of the Russian Federation on 1 December 2016, defines the priorities of scientific research and technological development of the Russian Federation for the next 10–15 years. Its primary goal is to deliver research and engineering results and create the

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technologies that will form the basis for innovation in the domestic market of products and services and ensure Russia's competitiveness on global markets.

The development of economic sectors (industry, agriculture, energy, transport, etc.) is having an increasingly significant impact on the environment and climate. The Strategy considers the increase of anthropogenic pressure – to the extent that it threatens the reproduction of natural resources, impacting the wellbeing of the population because of their inefficient use – to be the major challenge that creates significant risks for society, the economy and the system of public administration.

The issues of climate change and environmental regulation have become some of the principal topics in international relations. Over the past three decades, Russia has been lagging behind the world's leading countries in applying high technology to scientific research in the areas of the environment and climate change. The lack of scientific data in these areas of research impedes Russia's efforts not only in properly managing and mitigating environmental and climate risks, but also in effectively defending its socio-economic interests at the international level.

The success in the mitigation of the anthropogenic impact on the climate and the environment as well as in the adaptation of natural systems, the population and economic sectors to climate changes depends on how accurately the pace and intensity of such changes are measured, i.e. on the quality of scientific and analytical information that supports management decisions.

CURRENT STATE OF RESEARCH AND DEVELOPMENT

Climate and environmental observations are based on international observing systems run by leading developed countries. The existing global climate monitoring systems combine various platforms (land, sea, remote, etc.), operating in accordance with the established requirements (including the recommendations of the World Meteorological Organisation) that ensure the quality of the observed data. In addition to observations, these systems include physical and mathematical models that are used for performing global and regional retrospective analyses (reanalyses) of the climatic characteristics of the atmosphere, land and oceans. Such analyses allow to fill in the missing observational data. There are more than twenty atmospheric and more than ten oceanic global and regional reanalyses available to users around the world, which provide hundreds of high-resolution parameters for time periods from 40 to 100 years.

The Russian component of global monitoring systems is represented, first and foremost, by the State Observation Network for Climate Monitoring of Roshydromet (Federal Service for Hydrometeorology and Environmental Monitoring) as well as by the system of research vessel monitoring of key climate processes in the World Ocean, including the Russian seas, carried out by the organisations of the Ministry of Education and Science of Russia and Roshydromet. As for the original reanalyses, only one regional reanalysis has been performed by the P. P. Shirshov Institute of Oceanology of the Russian Academy of Sciences, namely a high resolution analysis of the ocean and atmosphere in the North Atlantic (NAAD).

Success in the mitigation of climate change depends on the quality of scientific and analytical information that supports management decisions

Monitoring of greenhouse gas fluxes between the atmosphere and the planet's surface is carried out using computational methods (including mathematical modelling methods), as well as experimental monitoring methods. The calculations of data related to the monitoring of anthropogenic greenhouse gas fluxes is done routinely by Roshydromet. In the field of experimental monitoring of greenhouse gas fluxes, there are several Russian sites where various observations are conducted, but their number is markedly small in comparison with leading foreign countries. In order to verify the calculation-based monitoring data and obtain reliable estimates of the emission and absorption of greenhouse gases by natural terrestrial and marine ecosystems, a pilot network of super-sites for greenhouse gas monitoring is currently being developed across Russian territory.

The Russian model of the global climate system, developed at the Marchuk Institute of Computational Mathematics of the Russian Academy of Sciences, is part of the international Coupled Model Intercomparison Project (CMIP), which is a source of climate modelling results for the Intergovernmental Panel on Climate Change. Other global models that exist in Russia (e.g. Voeikov Main Geophysical Observatory and Hydrometeocentre of Russia) do not participate in CMIP due to a lack of supercomputer resources. There are also simplified models of the climate system (Obukhov Institute of Atmospheric Physics of the Russian Academy of Sciences) and models of individual components of the Earth system (atmosphere, ocean, land hydrology) developed by scientific institutions of the Ministry of Education and Science of Russia and Roshydromet.

A multifunctional modular system of probabilistic projection of regional climate changes has been developed at the Voeikov Main Geophysical Observatory of Roshydromet, which can be used to create a high-resolution system for regional climate and environmental studies, predicting and projecting weather and climate impacts as well as practical applications, e.g. development of industry and regional adaptation strategies.

More than half a century of monitoring and research of atmospheric air pollution in cities in Russia, carried out by Roshydromet within the framework of the State Observation Network for Climate Monitoring, allowed to lay down methodological requirements for carrying out observations and to develop methods for calculating the dispersion of pollutants from various types of sources. An automated system for collecting, processing and storing primary information (ASOIZA) that has been created, is now functioning and has been accumulating data since 1980.

There is also a System for short-term forecasting of atmospheric pollution and warnings about adverse weather conditions for the dispersion of pollutants for 397 cities, which includes 76 forecast centres. Roshydromet monitors pollution, including radiation, of inland waters, seas and soils in Russia.

The system for monitoring the chemical composition of the atmosphere in Russia, unlike in a number of foreign countries, currently does not monitor the content of so-called “black carbon” in the atmosphere. Black carbon – the product of incomplete fuel combustion – is a hazard to human health and may have an impact on the regional climate (estimates of the severity of this impact vary significantly), so black carbon has a fairly prominent presence on the international climate agenda.

In terms of assessing the climate impact on the economy and the quality of life of the population, there are practically no Russian models of the direct impact on the state of social and economic systems, as well as influence on the state social and economic policies, corporate business policies and household behaviour, so foreign models are mainly used. In Russia, only a few econometric models are being developed to analyse adaptation decisions and their impact on social and economic development.

The mission of FSTP is to ensure the collection of internationally recognised observations and calculated data in the field of environment and climate

The existing research groundwork and know-how in the field of monitoring and predicting climate and environmental conditions in Russia can facilitate the creation of new advanced observing systems and models.

On the basis of such expert assessments, the overarching mission of FSTP is to ensure the collection of internationally recognised observations and calculated data in the field of environment and climate.

The goal of FSTP is to find science-driven solutions for obtaining reliable data on the environment and climate change and using this data in the interests of sustainable development, including the emission and absorption of greenhouse gases and environmental pollution, as well as physical and mathematical modelling of the Earth system.

1. Monitoring and predicting the state of the environment and the climate

The major issues with implementing environmental and weather/climate security measures are the collection of reliable data on the current state of climate and environment as well as generation of scenarios for their transformation based on quantitative assessments of the future of the Earth system (the atmosphere, processes on land, the World Ocean, the cryosphere and the biosphere) for time periods from several months to hundreds of years. To solve this problem we must develop and perfect monitoring technologies designed to provide the most complete and detailed information about the state and evolution of the Earth system and factors affecting it, including the emission and absorption of greenhouse gases, the evolution of atmospheric aerosols, as well as technologies of physical and mathematical modelling and predicting (using supercomputers) based on the use of constantly refined models of the Earth system and its individual components.

The fundamental problems of climate prediction remain the study of the predictability of the Earth system and the improvement of the quality (including increasing the spatial resolution) of climate predictions, as well as the study of the possibility of reducing the uncertainty (spread) of the current estimates of the sensitivity of the Earth system to anthropogenic impacts. Together with studies of the natural carbon cycle — including quantitative estimates of greenhouse gas emissions and uptake in forest and other ecosystems and based on the characteristics of landscapes, soils, vegetation cover and land use, as well as modelling of biological and biogeochemical processes — studies of predictability and sensitivity are necessary to determine economically justified possibilities to reduce anthropogenic impact on the climate system.

Monitoring and prediction of air quality, availability and quality of water resources, the state of natural and anthropogenically modified ecosystems and biodiversity are among the critical issues with the quality of life of the population in terms of both the environment and climate.

Diagnosis and reliable prediction of changes in the frequencies and characteristics of extreme and high-impact weather and climatic events are also crucial issues.

When implementing this part of FSTP, the integration of monitoring together with physical and mathematical modelling and prediction is critically important. Observations are necessary for creating models and evaluating their quality, and

model simulations, in turn, allow to optimise the development of observing systems and interpret observations, and subsequently to take these results into account in plans to adapt to climate change.

The goal of this focus area is to create science-driven technological solutions for obtaining reliable data for monitoring and modelling the environment and climate, as well as predicting their future conditions.

Conducting work in this focus area within the framework of the Programme will ensure that:

- Research and data contribute to the strategy of socio-economic development of Russia that aims at sustaining a low level of greenhouse gas emissions within the limits, approved in regulatory documents that deal with the assessment of greenhouse gas emissions and sequestrations;

- Research and data support environmental and climate risk management in Russia and adjacent territories and seas;

- It is in compliance with international agreements by the Russian Federation;

- It provides scientific evidence to support the position of the Russian Federation in international negotiations on climate issues, including full and objective accounting of greenhouse gas uptake by Russian forests and other ecosystems, and

- It supplies sufficient world-class cutting edge tools to the Russian scientific community for conducting a wide range of studies of the Earth system and creating projections for the state of the global Earth system at various temporal and spatial scales.

2. Mitigation of the anthropogenic impact on the environment and the climate

The development of low-carbon technologies for mitigating the anthropogenic impact on the environment and climate (ensuring sustainable and balanced socio-economic development of the Russian Federation) should be based primarily on the scientific evidence of the effectiveness of a particular set of technological solutions in Russian conditions in terms of balanced reduction of the emissions of pollutants and greenhouse gases and increase of the potential for carbon uptake by ecosystems.

The goal within this focus area is to develop a set of methods and models that help creating a system for assessing the feasibility and effectiveness of measures aimed at mitigating the anthropogenic impact on the environment and climate, as well as development and implementation of science-driven technological solutions aimed at mitigating the anthropogenic impact on the environment and the climate.

The work carried out within this focus area of the Programme will contribute to:

- Environmental safety, improvement in the quality of life of the population, technological modernisation and acceleration of the development of the Russian economy;

- The implementation of strategy for the socio-economic development in various Russian economic sectors and regions for sustaining low levels of greenhouse gas emissions and pollutants;

- The modernisation of the Russian economy on the basis of low-carbon technologies, the growth of the competitive advantage of domestic products, Russia's entry into new markets;

- The fulfilment of Russia's international obligations on sustainable development, and

- Scientific evidence supporting the position of the Russian Federation in international negotiations on the climate agenda.

3. Adaptation of natural systems, the population and economic sectors to climate change

The results of monitoring and predicting the state of the climate and environment show to what extent the country's economy and the social sphere are exposed to weather and climate risks and, therefore, enable planning of cost-effective adaptation measures, which will ensure social and environmental safety of the population and improve the quality of life.

The large number of factors driving climate change and the variety of their impacts on the environment, economic sectors and the quality of life of the Russian population dictate the need to develop and implement systemic adaptation measures with careful consideration of regional and industry specifics. Any delays in the adoption and implementation of adaptation strategies and plans, as well as any inconsistencies of the measures taken, may entail a significant increase in the potential for extreme events.

The goal of this focus area is to develop science-driven technological solutions that facilitate the creation of a system for assessing environmental and climate risks on Russian territory and adjacent seas in order to justify and adopt the necessary measures to adapt to climate change, taking into account regional and industry specifics, and to prove the effectiveness of their application.

Conducting work in this focus area within the framework of FSTP will ensure:

- Support of the environmental and climate services of state authorities, economic sectors, economic entities and the population;

- The optimisation of climate-driven decisions in terms of strategic planning of adaptations to climate change in various sectors of the

economy, including energy supply systems, transport and construction infrastructure, agriculture, water management and forestry, as well as health services;

- The development of analyses and forecasts of the impact of climate change on urban territories, as well as management of environmental and climate risks at various administrative and territorial levels;
- Effective control of environmental and climate risks while planning the development of coastal zones and seas of Russia, sustainable development of these coastal zones, as well as creation of the foundations for optimising social and investment policy in the economic and social spheres in coastal zones;
- The development of solutions for strategic planning and operations safety for various sectors of the economy in permafrost regions, and
- The development of recommendations for decision-making in investment policy and effective consideration of social risks, including those related to internal and external migration of the population.

EXPECTED RESULTS

On completion, FSTP will have developed the following systems:

- A system for monitoring greenhouse gas fluxes and the carbon cycle across the Russian territories and seas (including in-situ and remote monitoring) as well as a system for recording data on greenhouse gas fluxes and comparing against the carbon budget in natural ecosystems;
- A system for monitoring atmospheric black carbon in the Russian Federation;
- A system of climate and environmental monitoring of key climate regions of the World Ocean, coastal zones and seas of Russia;
- Climate monitoring systems for the terrestrial hydrosphere, glaciers, permafrost, vegetation cover and soils;
- A world-class global model of the Earth system for research purposes and generating projections of climate change;
- A multi-purpose system for modelling and predicting regional climates at a high spatial resolution to provide data and analyses to support environmental and climate risk management on Russian and adjacent territories and seas;

- Economic and mathematical models for assessing the socio-economic, environmental and climatic effects of the implemented and planned climate policy measures in relation to the national economy as a whole, as well as for evaluating decisions at the level of individual sectors of the economy and regions of Russia;

- A globally recognised methodology for creating an effective model for the use of low-carbon technologies, including greenhouse gas absorption technologies (this should also be tested);

- A modelling system to manage weather, climate and environmental risks for the social sphere and the economy;

- A scientifically proven system to assess the effectiveness of technologies for managing environmental and climate risks and adaptations to climate change to ensure sustainable development of coastal zones and marine resources of Russia; sustainable development of urban agglomerations; sustainable agriculture and forestry, including environmentally safe farming systems and their adaptation to climate change;

- Methods for assessing the effectiveness of management of forests, wetlands, farmland, coastal waters, focused on carbon deposition, and

- Science-driven technologies, the effectiveness of which is confirmed by FSTP results, and ensure these are utilised by technological partners of FSTP and other organisations.

Thus, the FSTP implementation will create an internationally recognised scientific body of work in the field of monitoring and modelling climate and environmental changes, the development of mechanisms for adapting to climate change and its consequences, and the development of measures to mitigate anthropogenic impacts on the environment and climate.

Additionally, FSTP will provide training and capacity building in the area of world-class multidisciplinary climate and ecosystem research, as well as the practical application of their results, including the adaptation to climate change and the mitigation of anthropogenic impact on the environment.

The implementation of FSTP shall achieve the following aims:

- To reach a world-class level in science-driven technologies for monitoring and predicting the state of the environment and the climate, including natural hazards, based on state-of-the-art observing systems and physical and mathematical modelling;

- To fully utilise the high adaptation potential of the Russian Federation and increase the effectiveness of climate change mitigation measures for various natural systems, social groups, regions and sectors of the economy of the Russian Federation;

- To develop and implement low-carbon, as well as environmentally friendly technologies into various sectors of the economy of the Russian Federation, and

- To give scientific basis to the implementation of effective measures to protect Russian producers from foreign restrictive measures introduced under the pretext of ensuring environmental and climate security.

PROVISIONAL FSTP IMPLEMENTATION PLAN

The implementation period of the Programme is 2021 - 2030. A detailed programme implementation plan is under development and will be finalised by the end of 2021. It shall include major programme modules, aggregated topical science projects and the mechanisms for their execution.

The following bodies will participate in the FSTP implementation:

- The Ministry of Natural Resources and the Environment of the Russian Federation, the Ministry of Science and Higher Education of the Russian Federation, the Ministry of Economic Development and the Federal Service for Hydrometeorology and Environmental Monitoring and state authorities of the constituent entities of the Russian Federation;

- Russian Academy of Sciences, funds for supporting research and technical innovative activities, research and development institutions, and

- Science and education organisations, as well as other organisations of various forms of ownership or associations of such organisations, that have scientific and technical expertise, experience and personnel capacity.

Russian organisations in the sectors of the real economy of various forms of ownership will be involved in the Programme as technological partners.

Efforts of the FSTP participants will be coordinated by a permanent collegial body – the Council for the implementation of the Programme under the leadership of Victoria Abramchenko, Deputy Prime Minister of the Russian Federation, and Sergei Ivanov, Special Presidential Representative for Environmental Protection, Ecology and Transport.