

**CONCEPT OF ORGANIZATION AND IMPLEMENTATION OF THE  
INTERNATIONAL YEAR OF  
GLACIERS PRESERVATION (IYGP) IN 2025**

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## **Abbreviations**

IYGP- International Year of Glaciers Preservation

IPY- International Polar Year

UN- United Nations

IDGP- International Day of Glaciers Preservation

WMO – World Meteorological Organization

AO - Arctic Ocean

USSR- Union of Soviet Socialist Republics

NP- North Pole

IGY- International Geophysical Year

ISC- International Scientific Committee

ISC - International Science Council

SSI GRC NAST - State Scientific Institution «Glacier Research Center» of the National Academy of Sciences of Tajikistan

CA- Central Asia

RSD- Remote sensing data (GIS)

OC - Organizing Committee

CAR – Central Asian region

## Introduction

The study of mountain and polar processes is important for weather forecasts at polar and midlatitudes. It is necessary to study the high altitude zones of Arctic and Antarctica, as important parts of the global climatic system, connected with its other parts, heat, moisture and water transfers by atmospheric and ocean circulation.

Over the past 100 years, the average global air temperature has increased by  $0.6\pm 0.2^{\circ}\text{C}$ , and its variability in the Arctic being the greatest. Throughout the 20th century, warming in the Arctic was replaced by cooling and, in the last two decades, there is warming again. The spatial pattern of climate change as in the Arctic, Antarctica and as in mountainous regions is heterogeneous.

There is no unequivocal answer to the question of what will be the climate in the high-altitude zones of the Arctic, Antarctica, and the Earth as a whole in the twenty-first century is not yet available. There is also no answer about

the state of the world's glaciers and water resources. However, it is clear that long-period climate variability can primarily affect glaciers and the cryosphere as a whole, economic activity and the way of people live. The changes may particularly affect the interests of many active countries in the polar, subpolar and high mountain regions of the Earth.

Anthropogenic impacts particularly affect polar, subpolar, and high mountain ecosystems and, ultimately, human health and quality of life. Increasing anthropogenic impacts in the areas of current and future economic activity makes it necessary to conduct research to assess their manifestations and develop measures to reduce the negative consequences.

These problems have circumpolar nature, and international cooperation should play an effective role in solving them. International year of glaciers protection in 2025 (IYGP) - a form of cooperation that combines for a certain period of time the activities of international and national programs and projects implemented in the nival high-altitude zones of the Arctic and Antarctic.

One of the key scientific goals of the IYGP will be to study the physical, biological, and social connections between the nival highlands, the polar regions, and the rest of the globe, that will create opportunities for communication among a wide range of scientific disciplines and for connecting with education at all levels and general public.

**What is the International Polar Year and the Year of Glacier Conservation?– The polar and high-mountain nival regions are the main place of formation and accumulation of a huge number of glaciers.** IPY- International polar year and International Year of Glaciers Preservation - a form of cooperation that combines for a certain period of time the activities of international and national programs and projects implemented in the Arctic and Antarctic and equivalent areas of the Earth, i.e. high nival regions. A coordinated international approach has maximum impact on both the results of scientific research and its economic efficiency. The international cooperation that has begun today will make it possible to build the kind of relationships and understanding that will benefit society for a long time to come.

Such international cooperation that has begun today, as the IYGP, will build the kind of relationships and understanding that will benefit society for a long time to come.

### **Historical background of IYGP- 2025**

The idea of organizing the IYGP has been widely discussed in scientific circles around the world for several years. Extensions of the IPY were also discussed. For the first time in 2009 at the Conference of the Parties (COP15) on climate change in Copenhagen, the President of the Republic of Tajikistan at the high-level meeting on climate change focused on the problems of intensive melting of glaciers and the need for international cooperation to protect glaciers.

There were prerequisites and good reasons for this - Tajikistan took an active part in the IPY and organized its first Antarctic expedition in 2008-2009 under the IPY with the support of the Russian Federation. In scientific circles and at the highest international level, the issue of extending the IPY was discussed, but it did not find support.

In Copenhagen, the first results of the Tajik Antarctic Expedition were reported at the COP-15 in a separate session on the topic of: "Comparative Analysis of the Status of Glaciers in Tajikistan and Antarctica" which received high praise for such a wide-scale experiment.

It should be noted that glaciers are an integral part of the cryosphere and water resources. Tajikistan is globally recognized as a leading country in water initiatives. There were supported four Tajikistan's initiatives on water at the international level. Fifth Initiative by decision of the UN General Assembly (December 14, 2022) and the proposal of the Founder of Peace and National Unity - Leader of the Nation, President of the Republic of Tajikistan, Honorable Emomali Rahmon 2025 has been declared as the " International Year of Glaciers Preservation" and March 21 is celebrated as the International Day of Glaciers Preservation (IDGP). Moreover, in 2025, an international conference will be held in Dushanbe on the protection of glaciers and the allocation of a trust fund for the protection of glaciers is planned, which has received strong support at the national, regional and, respectively, at the global level.

Assuming that the concept of the IYGP encompasses a broad set of scientific disciplines and includes the cryosphere, glaciology, and climate and environmental monitoring components, contributing to the intensification of scientific research and the development of infrastructure for operations and research in the high

altitude and polar regions during the preparation and implementation phases of IYGP 2025 is essential.

Member countries, intergovernmental and non-governmental organizations should also be encouraged to contribute as much as possible to the implementation of the IYGP by providing logistical support and technical facilities at the national and international levels and propose to the World Meteorological Organization (WMO) the preparation and implementation of the IYGP. And also to organize active work on the formation of national scientific programs that are an integral part of international programs.

The Republic of Tajikistan, under the leadership of the Founder of Peace and National Unity - Leader of the Nation, President of the Republic of Tajikistan, Honorable Emomali Rahmon, has taken a key role in the world policy of protecting glaciers and water resources.

Recent history shows that Tajikistan, among other members of the international community at the global level, actually remains one of the initiators of active actions on the rational use and effective cooperative management of water resources.

The Republic of Tajikistan is the main promoter of the five global water initiatives:

1. Proclaiming of 2003 as International Year of Freshwater by the Resolution of the 55th session of the UN General Assembly of December 20, 2000, 55/196;
2. Proclaiming of 2005-2015 as International Decade for Action "Water for Life" by the Resolution of the 58th session of the UN General Assembly of December 23, 2003, 58/217;
3. Proclaiming of 2013 as International Year of Water Cooperation by the Resolution of the 65th session of the UN General Assembly of December 20, 2010, 65/154;
4. Proclaiming of 2018-2028 as International Year of Water Cooperation by the Resolution of the 65th session of the UN General Assembly of December 20, 2010, 65/154;
5. Resolution of the 77th Session of the United Nations General Assembly of 14 December 2022 on:
  - declaring 2025 the International Year of Glaciers Preservation;
  - declaring March 21 the International Day of Glaciers Preservation;

- establishing an international trust fund under the United Nations to help preserve glaciers;
- holding an International Conference on Glacier Protection in Dushanbe in 2025.

In the purpose of implementing this Resolution at the UN the present Concept was developed.

### **Historical facts about large-scale studies of glaciers at the international level and their importance for Tajikistan**

In the 1st IPY (1882-1883), scientists from 12 countries conducted geophysical, meteorological and biological observations at 13 points in the Arctic, as well as at Cape Horn and South Georgia Island in the South Polar Area. These observations were of great importance for the study of the Arctic climate, its air currents, ice conditions, magnetic variations and aurora borealis. This was the first experience of international cooperation in the history of scientific research. The history of the first IPY has been recounted many times.

In these years, meteorological research began to be actively conducted in Central Asia, in particular in Khujand, Istaravshan and Pendzhikent. After summarizing the results of the first IPY, they began to pay special attention to the meteorological conditions of the high altitude, especially in the glacier zones. The first high-mountain meteorological station "Murghab" was established in 1884 in Pamir. It made it possible to conduct continuous observation of the weather in high altitude conditions. It was an invaluable contribution, for that time, to the understanding of hydrometeorological processes in the world, as they began to receive not only information about weather conditions in the polar regions, but also in the highlands.

During the 2nd International Polar Year (1932-1933) observations were made at weather stations in the Soviet Arctic sector located on the shores and islands of the Arctic Ocean (AO). During the 2nd IPY, the hydrometeorological network in the polar regions was expanded. From the Union of Soviet Socialist Republics (USSR), 115 stations participated in the 2nd IPY, 50 stations of which were new. In addition, ship expeditions in the Arctic seas studied the ice regime and ice properties.

An important development of the 2nd IPY in the study of the Arctic was the opening in 1937 of the first drifting station at the North Pole. The unique transpolar flights of Soviet pilots from the USSR to America provided precious material on the structure of the atmosphere of the polar regions.

In 1937, the 2nd IPY played a crucial role in development of hydrometeorological and ice forecasting methods, determining the features of the hydrometeorological regime of the Arctic in studies of glaciers, geomagnetic field, radio wave propagation etc.

The IPY contributed to a large-scale study of glaciers and snowfields state under meteorological conditions in Tajikistan. Consequently, the formation of hydrometeorology in Tajikistan precisely falls on this period. In 1933, the Department of Hydrometeorology of the Republic of Tajikistan was organized. Meteorological stations were also organized in Gharm, Pyanj, Khorog, Kulyab, Isfara, Dushanbe, Khovaling and Kalai-Khumba. The Tajik-Pamir expeditions of the 1930s made it possible to compile a detailed geological map of Tajikistan and obtain important information about mineral reserves. In 1933, completed the construction of a unique meteorological station on the Fedchenko Glacier at an altitude of 4169 m above sea level. It was the largest high-altitude station in the world. The first information was received on November 7, 1933 (unfortunately, there are currently no observations at this station since 1994). During this period the creation of the hydrometeorological observation network allowed Tajikistan, as an integral part of the USSR, to take an active part in the implementation of the IPY program.

The International Geophysical Year (IGY) held in 1957-1958 was a development of the IPY ideas. Dozens of stations operated in the Soviet Arctic under a special program, and comprehensive research was begun in the Antarctic, in which the USSR took an active part by conducting annual Antarctic expeditions. During these years, new findings about the atmosphere, the ocean, and glaciation in both polar regions was obtained, a number of major international projects for studying various components of the polar environment were initiated, and the era of space research began.

**Main results of the 2nd IPY in Tajikistan:** The glaciations of the Northwest Pamir have been discovered and studied. This is the last major geographical discovery of the 20th century.

The largest mountain glacier in Tajikistan, the USSR and the Earth, Fedchenko Glacier, was discovered and mapped.

The world's highest hydrometeorological station was built on the Fedchenko Glacier.

1932 - Tajik-Pamir expedition of the USSR Academy of Sciences. Opening of Stalin Peak (7495 m, since 1962 - Communism Peak, now renamed Ismoili Somoni Peak). Outstanding geographical discovery - the unlocking of "Harmo's Knot".

In 1933, the Academy of Sciences of the USSR organized a large Tajik-Pamir expedition with the participation of 215 scientists and about 400 staff employees, porters, etc. Both scientific and athletic results were achieved. Climbing the peak of Stalin (Communism since 1962. Since the 90's peak Ismoili Somoni) - 03.09.1933. The deciphering of the last Pamir "white spot" was completed.

The result of successful international cooperation was the Antarctic Treaty and the Scientific Committee on Antarctic Research (SCAR).

The most active studies of glaciers in Tajikistan began precisely during the IGY period. During this period, more than 100 Soviet and foreign researchers worked on the Fedchenko Glacier. They obtained unique scientific material on the state of the glaciers. As a result of the IYG in Tajikistan, a series of scientific publications were prepared, and also there was prepared color Atlas which obtained comprehensive information not only about meteorology, but also about the state of glaciers, snowfields, and in general about water resources of Tajikistan.

### **3rd IPY (2007-2008)**

The 3rd IPY, held under the auspices of WGMS and WMO, was a truly international, interdisciplinary initiative which involved more than 160 international scientific projects, prepared on the basis of project proposals from more than 60 countries, including Tajikistan.

**Main results of the 3rd IPY in Tajikistan:** According to the government al decree, an Organizing Committee for the IPY in Tajikistan was established. By support of the President of the Republic of Tajikistan, the First Tajik Antarctic Expedition was organized and assisted by the 54th Russian Antarctic Expedition. On January 6, 2009 they hoisted the flag of independent Tajikistan in Antarctica. Resumed large complex international scientific Pamir expeditions. The "Museum of Antarctica" was officially established in Dushanbe. As part of the constructive policy of the President of the Republic of Tajikistan, honorable Emomali Rahmon, for providing practical support to the IPY, was established State Scientific Institution «Glacier Research Center» of the National Academy of Sciences of Tajikistan. We created a scientific school of glaciologists in Tajikistan, resumed basic research on the cryosphere, which allowed to create a catalog of glaciers based on the latest technology. To strengthen the scientific potential, specialists are trained in master's, postgraduate and doctoral courses (PhD) in glaciology. There was established a regular publication of the scientific journal "Cryosphere". A glaciological network is organized at altitudes from 3,500 meters to 5,000 meters, which allows direct observation of glaciers, and such high-altitude stations are singular.

The IPY 2007-2008 was a large-scale international scientific experiment, which includes coordinated in time, space and methodological support scientific activities for collecting and analyzing factual data on the state of the environment in key areas of the Earth's polar regions. The active phase of the IPY lasted from March 1, 2007 to March 1, 2009. During the IPY period, 159 sea and land Russian expeditions were conducted in the Arctic and Antarctic.

Oceanographic observations have shown that the temperature of Atlantic intermediate waters entering the Arctic Ocean has increased by 1.01.5 °C compared to the 1970s. Atlantic waters have risen to the ocean surface by 20-80 m, i.e. the thickness of the upper layer of desalinized water, formed by river runoff, precipitation and ice melt has decreased.

As highlighted in the statement of the Joint Committee of the WGMS and WMO on "State of the Art of Polar Research", for the first time in the history of IPY – IGY scientists in the physical and natural sciences and the social sciences worked together in a single interdisciplinary research program. This new form of interdisciplinary cooperation is perceived as one of the achievements of the IPY and its lasting legacy.



"The work started by the IPY must continue"- said Mr Michel Jarraud, WMO Secretary General. "The need for international cooperation in the polar regions will continue for decades to come," he said. Ms Catherine Bresignac, President of the International Science Council, supported this view: "The IPY has further strengthened the ISC-WMO relationship in the coordination of polar research, and we must continue to assist the scientific community in seeking ways to understand and predict change in the polar regions and its global implications during this critical period.

### **Scientific background**

In the study of the Earth's environment, the polar as well as the high altitude areas occupy a special place because of their inaccessibility and the role that they play in global changes in the natural environment. Features of the natural environment of Antarctica, the Arctic and the high altitudes - low temperatures, ice cover, permafrost, vulnerability of ecosystems are major factors significantly affecting the socio-economic complex, energy, transport and indigenous lifestyles.

Changes in the natural environment of Antarctica and Arctic, and especially the highlands where continental water resources are formed, under certain scenarios can threaten the established world economy.

The IPY has played a major role in the development of the national hydrometeorological support system not only in the Arctic and Antarctic, but also in Tajikistan.

The first IPY and IGY took place at different stages of the modern evolution of the Earth's climate - cooling at the end of the 19th century, warming in the 1920s and 40s, most noticeable in the Arctic, and cooling in the 1950s and 70s, and now that IYGP 2025 has been announced, there is a significant climate warming, especially in the last two decades of the 21st century. Unidirectional changes in polar climatic conditions can have significant impacts not only on polar regions, but also on the entire globe, natural environment, socio-economic activities and the health of humanity as a whole. Therefore, the problem of predicting climate change, which cannot be solved without the development of a modern environmental monitoring system, is extremely important for polar and equivalent regions, i.e. high altitudes.

An important area for establishing of various activities in the polar regions and high altitudes is the prediction of atmospheric, hydrological processes and

especially the condition of glaciers. It is based on an observation network comprising stations, automatic facilities and space-based observation facilities. Development and modernization of the observation network in mountainous conditions especially in the high altitudes of Tajikistan, the creation of new forecasting methods, the study of processes important for improving forecasts is necessary to ensure the successful development of Tajikistan's activities in the high-altitude conditions of the 21st century.

Mountain and polar ecosystems, are very sensitive to anthropogenic impacts and changes in natural and climatic conditions. Therefore the areas most exposed to pollution, combined with possible significant climate change, require special attention. The cumulative impacts can have profound effects on mammals, birds, fish and ultimately on the activities and lifestyles of Arctic and highland indigenous peoples.

### **Tajikistan's national interest in the implementation of IYGP 2025**

Tajikistan is interested in hosting the IYGP-2025 and is making arrangements for the preparation and organization of this major international scientific event.

Tajikistan's national interest in the implementation of IYGP-2025 is generally linked to the strategic areas of sustainable development, especially the economic development of mountainous areas (which accounts for 93% of the territory), ecological and environmental management issues, and problems of the mountain population.

In the glaciological conception of (State Scientific Institution) SSI «Glacier Research Center» (NAST) the objectives for the implementation of glaciological, cryospheric and hydrometeorological activities in Tajikistan in the functional and regional directions of the national mountain policy have been defined. These include the tasks of providing glaciological hydrometeorological information to all infrastructures, maintaining and developing a unified system of information on hydrometeorological and glaciological conditions in mountain regions.

Provisions of the concept which were noticed will make it possible to achieve the strategic goals of the country in terms of socio-economic development of Tajikistan until 2030. aimed at increasing the level of national security (including reducing the threat and possible damage from natural and human-made disasters), ensuring high rates of sustainable economic growth of the country and the development of its scientific potential.

Preparing and sustaining research structures for their tasks during the IYGP period will ensure the presence of Tajik researchers not only in the high altitude areas (where no systematic research has been carried out since the 1990s), but also in Antarctica and Arctic. It should be noted that Tajik researchers in the 1980s were among the most active explorers of Antarctica and had their own scientific programmes. The state interests of Tajikistan's participation in IYGP 2025 are defined by the following group of issues:

Geopolitical problems. The possible increase in water consumption under a warming climate will increase the interest of other countries, especially the Central Asian republics, in Tajikistan's water resources, which may exacerbate problems of the international legal status of transboundary waters, including water resources located in Tajikistan's territory.

The further development and enhancement of Tajik scientific research in the mountainous regions of Tajikistan and in Antarctica is the main part of the implementation of state policy, aimed at preserving and consolidating Tajikistan's position not only in Central Asia, but also at securing its long-term interests at the global level.

Military security in mountainous and high altitude areas. The activation of neighbouring mountain states as a result of possible improvements in transport links will entail inevitable changes in military activity, primarily in neighboring states with political and military instability, need to be considered in solving the strategic and tactical tasks of securing the interests of Tajikistan.

The transport system. Possible changes in freight, transport conditions and the development of mountain economies could contribute to the transformation of remote mountain regions into a transit year-round transport artery in demand by the world community, especially in the Pamir direction. Developing a long-term strategy for infrastructure development in mountainous regions and defining the transport system is impossible without taking into account the changing natural and climatic conditions of mountainous and high-mountainous zones.

Water resources development and exploitation. The construction and exploitation of hydropower plants in Tajikistan's mountainous regions ensure the country's energy independence. However, changes in natural conditions will affect the economic efficiency of energy projects and must be reliably predicted, especially under conditions of global warming. Reductions in the volume of glaciers in the mountains of Tajikistan are not excluded by the forecasts until 2050. Possible changes in glaciers and snowfields have a significant impact on hydro

resources and naturally on energy security not only for Tajikistan, but also for the whole Central Asian (CA) region, including Afghanistan and Pakistan.

Development of minerals and bio-resources. The agricultural, industrial and transport development of Tajikistan's mountainous areas is linked to the state and conditions of the mountain ecosystem and their natural and anthropogenic changes. The condition of small glaciers at river mouths can play a prominent role in the traditional way of life of mountain peoples. Changes in mountain ecosystems can affect the entire livelihoods of people living in mountains.

Environmental protection and ecological policy. Familiarity with natural and anthropogenic changes in mountain ecosystems underpins conservation policy, including bioresource management. The implementation of environmentally hazardous projects (e.g. the disposal of spent industrial and radioactive waste) is not feasible without assessments of possible long-term changes to the natural environment.

Socio-economic problems. The state and changes in the environment and activities serve as important factors for the socio-economic complex of mountain regions. The direct and indirect impacts of extreme climatic and heliogeophysical conditions on mountainous populations are particularly acute. An assessment of the health status of the population living in mountainous areas, especially high mountain areas, will make it possible to carry out comprehensive measures to improve their health.

### **Global goals and targets of IYGP 2025**

The purpose of the IYGP is to determine the current and future state of glaciers, snow cover and the cryosphere against the background of climate change, to assess the state of the natural environment and the impact of climate change in order to develop practical recommendations for the sustainable socio-economic development of high altitudes and polar regions.

IYGP-2025 is a large-scale international scientific experiment, involving coordinated in time, space and methodological support scientific activities to collect and analyze data on the status of glaciers, snow cover and the cryosphere in key high altitude areas and polar regions of the Earth for:

- determining current and assessing future climate changes in the nival high altitude areas, polar regions and their manifestations in the natural complexes of the Arctic and Antarctic;

- development of technologies for monitoring and forecasting processes in the atmosphere, ocean, land water, Near-Earth space in the nival high-altitude and polar regions;
- assessment and forecasting of environmental pollution in nival high-altitude areas, polar regions, and their impact on the ecosystems of these areas;
- assessment of the impact of specific high altitude, polar natural-climatic and environmental factors on the livelihoods and activities of the population;
- providing recommendations for accounting the changing climate and environment for sustainable socio-economic development and environmental management.

The main purpose of Tajikistan's participation in IYGP 2025 is to obtain new knowledge about glaciers, snow cover, cryosphere, hydrometeorological and geophysical processes in the mountainous and high altitude regions of Tajikistan.

The goal will be achieved by a significant increase in methodologically coordinated glaciological, hydrometeorological and geophysical observations, development of tools and methods for the integrated study, assessment and forecast of the natural environment, socio-economic and health in mountain and high-altitude regions in a climate changing conditions.

**The Tajikistan studies in the IYGP 2025 period are envisaged to:**

- expand the program of glaciological, cryospheric, meteorological, biological and medical observations in the mountainous and high-altitude areas of the Republic;
- conduct glaciological expeditions in the mountainous regions of Tajikistan and the Central Asian region, using personnel and technical resources from international organizations and neighboring states;
- equip key high-altitude glaciological and meteorological stations with instruments and equipment for climate and snow-glacier observations, and expansion of the station work program in line with the priorities of IYGP 2025;
- resume stationary observations of the largest glacier in Central Asia - Fedchenko - at the meteorological station named after Nikolai Petrovich Gorbunov;

- develop information system, GIS (RSD-Remote Sensing Data) and database on glaciers and hydrometeorological conditions using spatial imagery and field observations;
- cooperate and information exchange with the world's glacier research centres in Switzerland, Germany, Russia and elsewhere;
- increase knowledge and awareness of the country's glaciers and potentially dangerous glaciological processes;
- assess the factors influencing local and global climate change and identify trends;
- collect palaeoclimatic information and assess the current state of the terrestrial high altitude components of the cryosphere (glaciers and permafrost) to predict their evolution under different climate change scenarios;
- assess the state of mountain ecosystems under climate changing and anthropogenic influences, and develop recommendations for conservation activities;
- establish an information fund on mountain areas and ensure its effective use for the analysis and interpretation of data by different classes of users;
- promote the implementation of international projects on research of regions equated to polar areas, conducted by international organizations, in which Tajikistan participates as a initiator;
- develop recommendations to ensure further sustainable socio-economic development of high altitude areas equated to the polar regions.

**For Tajikistan, the priority practical activities of IYGP 2025 could be:**

- modernization and development of the observation system for glaciers and hydrometeorological conditions using space-based, ground-based and other types of observation in mountain areas;
- conducting comprehensive high-altitude expeditions with international partners in Pamir and improving the activities of mountain and high-altitude expeditions;
- conducting comprehensive joint Tajik-Russian high-latitude expeditions in the Arctic and Antarctica;
- developing and improving the system of climate and environmental monitoring in mountain regions.

## **Summary of the Action Plan of the Republic of Tajikistan for IYPL 2025**

The preparation of the IYGP-2025 National Science Program is open to participation: all ministries, departments, academic institutions, institutions of higher education, and other interested organizations.

The State Scientific Institution «Glacier Research Center» of the National Academy of Sciences of Tajikistan has developed a Scientific Program, Action Plan for the preparation and conducting of IYGP-2025, which includes:

1. Conducting a coordinated collection of data on the state of the natural environment in the mountainous regions of Tajikistan in time, space and methodological support.
2. Developing unified database on the cryosphere, snow cover, glaciers, hydrometeorological, bioresource, geological and geophysical, regulatory, socio-economic and other data on high altitude regions, developing procedures for managing data and making information available for public use.
3. Determining current and assessment of future climate changes in mountainous areas, development of monitoring and forecasting processes in the atmosphere, hydrosphere, and cryosphere, assessing anthropogenic and natural changes in the environment and their impact on the national economy, human health and ecosystems.
4. Developing recommendations for sustainable socio-economic development in climate and environment changing conditions in mountainous regions.

During the development of the national IYGP program it is necessary to form and, in accordance with the recommendation of the Joint International Committee of the IYGP, propose to the International Program Office of the IYGP a package of proposals on the activities of scientific organizations of Tajikistan during the IYGP-2025.

In the period of 2025 it is supposed to perform a wide range of full-scale studies. The subjects of Tajik proposals submitted to the Joint International Committee of the IYPL-2025 include comprehensive studies of the state of glaciers, snow cover, cryosphere, and the natural environment, studies of the climate and paleoclimate of mountain areas, the atmosphere, and mountain ecosystems. These developments form the basis of the Action Plan for Tajikistan's participation in the preparation and Implementation of the IYGP 2025.

The Organizing Committee (OC) for Tajikistan's participation in the preparation and conduct of the IYGP-2025 should be established and supported.

### **Short overview of scientific proposals for the IYGP-2025 period**

Cryospheric studies are presented by projects to study the causes and consequences of accumulation and melting of snow and glacier cover in the

mountain regions of Tajikistan during the IYGP against the background of its long-term variability and the study of small and large mountain glaciers as indicators of climate change.

Ecosystem studies of mountain areas include the study of the state of biological complexes of high altitude regions under current conditions of global warming.

Climate projects include studies of natural complexes, socio-economic conditions, and public health as part of comprehensive studies of mountain areas.

Climatic research is represented by a project to study the climate variability of mountain regions and glaciological studies of glaciers.

Much attention will be paid to studies of the cryosphere of mountain regions, which are based on the study of the state of glaciers and the flow of mountain rivers.

### **Scientific and thematic areas of IYGP-2025:**

#### **Scientific Topics:**

1. Methods of glacier protection (chemical, technical and biological) and their practical use.
2. Cryosphere, glaciations and glaciers.
3. Mass balance of glaciers.
4. Mode and variation of glaciers.
5. Application of remote sensing and GIS-technology in the study of glaciers.
6. Space and aero-visual studies and monitoring of glaciers and snow cover.
7. Glacial lakes and breakthrough glacial lakes.
8. Melted runoff.
9. Hydrochemical and isotopic studies of glaciers and snow cover.
10. Underground glaciers and permafrost.
11. Paleoglaciology and paleoclimatology.
12. Innovative methods of research on glaciers and snow cover.
13. Modeling in glaciology, snow cover and melt runoff.
14. The climate system and climate change.
15. Development of a network of systematic observation of glaciers, snow cover and hydrometeorology at an altitude of 3,500 to 5,000 meters.
16. Hydrology and glacial hydrology.
17. Snow cover.
18. Snow avalanches and glacial mudflows.
19. Ice formation and glaciers in the Arctic.
20. Ice formation and glaciers in the Antarctic.



21. Dynamics of glaciations and glacier changes in the Arctic and Antarctica.
22. Sea, lake and river ice.
23. Rational use and regulation of snow and ice resources.
24. Snow and ice conditions of economic activity.
25. Natural disasters and hydrometeorological phenomena associated with glaciers, snow cover and glacial mudflows and methods of reducing damage from their consequences.
26. Socio-economic aspects of climate change and the consequences of intensive glacier melting and glacial lake outbursts.
27. Medico-social, sanitary condition and health of peoples living in subpolar and high-altitude areas in conditions of intensive melting of glaciers.
28. Building educational and scientific capacity in the field of glacier research and protection, and sharing knowledge with the general public.

All these scientific topics are summarized in the following thematic areas:

**Thematic area 1. Cryosphere and glaciology.**

Section 1.1. Permafrost .

Section 1.2. Glaciology.

**Thematic area 2. Hydrometeorology.**

Section 2.1. Meteorology .

Section 2.2. Hydrology.

**Thematic area 3. Natural disasters.**

Section 3.1. Avalanches and mudflows.

Section 3.2. Glacial lake outbursts.

**Thematic area 4. Isotopic and hydrochemical studies.**

**Thematic area 5. Scientific and expeditionary works.**

**Thematic area 6. GIS-technology, remote sensing, drones.**

**Thematic area 7. Modeling and Forecasting.**

**Thematic area 8. Medico-social and sanitary condition.**

**Thematic area 9. Educational and scientific capacity building.**

**Thematic area 10. Development of measures for the protection of glaciers.**

**Thematic area 11. Others (can be supplemented if necessary).**

## **Conclusion**

The development of the system of glaciological, cryosphere and hydrometeorological monitoring and hydrometeorological support of economic activity will reduce the negative effects of climate change and increase the efficiency of economic activity in mountain areas through the timely accounting of unfavorable hydrometeorological conditions.

Glacier monitoring and geodynamic observations of mountainous areas will make it possible to find new solutions to the problems of glaciations change assessment, permafrost melting, soil erosion, and monitoring of anthropogenic impacts.

High-quality assessment, improvement of knowledge of the natural environment and forecasting of possible changes in the future are necessary for reliable provision of hydrometeorological and glaciological information to assess hydropower, food and economic security of the republic and the CAR (Central Asian region) as a whole.

The results of IYGP-2025 will preserve the national heritage - the results of various generations of Tajik, Soviet and other researchers in the mountain and polar regions of the Earth for future use. The accomplished work will create the potential for the development of scientific research and information support activities not only in the polar regions, but also in the mountainous regions, which will make a significant contribution to the development of national and world science. The results will make it possible to understand the limits of the natural variability of the climate system and to assess the trends of future climatic changes, and will form the basis for improving the quality of natural resource forecasting.