SOLUTIONS FOR SUSTAINABLE ECONOMIC DEVELOPMENT

4th ARCTIC SCIENCE MINISTERIAL REPORT

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April 14-15, 2023 | St. Petersburg, Russia

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Rybachiy Peninsula (Murmansk, Russia)

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The Lofoten Islands (Norway)

EXECUTIVE SUMMARY

Arctic Science Ministerial is a unique form of scientific cooperation that traditionally advocates preserving the Arctic region as a territory of peace, stability and constructive interaction focused on achieving concrete, practical results in the interests of all people in the northern latitudes, including indigenous peoples.

The Russian Federation continues the coordinating functions within the ASM adopted from previous coordinators on June 16, 2021 at the final ASM3 webinar, and on October 14, 2021 in Reykjavik, Iceland at the annual international Arctic Circle Assembly, based on the continuity of previous ASM and the increasing relevance of scientific research in the Arctic.

This book provides an overview of past events - webinars, participation in conference roundtables - with the aim of sharing scientific experience of Arctic research and forming informational materials to support science and higher education activities through international organizations and forums in the Arctic zone, supporting and updating the database of Arctic research projects carried out by scientific and educational organizations, including jointly, as well as through international.

The information base for this work was the results of feedback assessment from Russian and foreign scientific and educational organizations, data on international projects in the Arctic, materials from the websites of the Arctic Council https://arctic-council.org/ and the working groups of the Arctic Council. In addition, climate, geological, biological, sociological, and technological research was used as the basis for developing strategies for sustainable economic development in the Arctic that take into account the interests of all stakeholders, including indigenous peoples, environmental organizations, industry, and government agencies.

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Rybachiy Peninsula (Murmansk, Russia)

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The Lofoten Islands (Norway)

SCIENCE SUMMARY

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SOLUTIONS FOR SUSTANABLE ECONOMIC DEVELOPMENT

The Russian Chairmanship aims to increase the efficiency of scientific activities and the practical applicability of their results in the Arctic. We intend to optimize the use of scientific infrastructure, promote the use of advanced technologies and best practices in the implementation of joint projects.

The focus is on topics important for the sustainable development of the Arctic region.

They **include** the need to improve living conditions in the Arctic region, environmental issues, adaptation of life in high latitudes to climate change, biodiversity conservation, as well as the growth of tourism, all of which require collective efforts of all ASM4 participants.

In the Joint Statement of ASM3, the participants noted the importance of further strengthening international research cooperation and agreed on a number of important issues. Similar to the previous ministerial meetings, we asked countries and indigenous peoples' organizations to provide an overview of Arctic research, including research objectives, sources of research funding for the country/organization, key research initiatives and research infrastructure, and the results of the goals set at ASM3.

4th ARCTIC SCIENCE MINISTERIAL

We believe it would be useful to organize focused work on developing mechanisms for implementing **the Agreement on Strengthening International Arctic Scientific Cooperation**, given the complexity of harmonizing existing national regulations on conducting research in the exclusive economic zones of states.

In its turn, Russia supports comprehensive research programs in the Arctic aimed at strengthening scientific and technical cooperation in various fields.

At the same time, joint work on coordination of research programs would improve the efficiency of scientific work, optimize the use of scientific infrastructure, and apply advanced technologies and approaches of ASM participants.

A key challenge for the Arctic region remains monitoring ongoing climate change and its impact on unique Arctic ecosystems. The vulnerability and long-term nature of ecosystem restoration in the Arctic bring to the forefront the development of international scientific cooperation in developing high-impact environmental projects.

The content and format of **the Arctic Science Ministerial (ASM4)** was determined based on the continuity of previous ASMs and the growing relevance of research in the Arctic, including those related to pronounced changes in the Arctic climate. **ASM4 provides** an accessible, open and equally cordial dialogue and interaction with the Arctic population and the international scientific community.

At the same time, the Russian Federation proposed to include in its agenda a new priority activity in the form of **Theme 5 "Solutions for Sustainable Economic Development"**. The main objective of the new theme was to maintain the formed database and work out the option of further development of the information exchange mechanism.

Also earlier, it was proposed to systematize international scientific projects of the Arctic zone countries based on the Russian proposals regarding the main priorities in the field of scientific cooperation in the Arctic Council.

Cooperation with leading scientific and educational organizations both in Russia and abroad allowed to form **a list of priorities for the main directions of international scientific cooperation**, corresponding to the main topics of ASM4, namely:

THEME 1: OBSERVATION

OBSERVATION NETWORKS, DATA EXCHANGE

- Creation of intelligent transport and telecommunication systems for Arctic development
- Development of methods and means of monitoring and forecasting of the Arctic environment
- Joint international complex monitoring of the Arctic environment, including the state of the atmosphere, hydrosphere, cryosphere and geophysical situation on the basis of permanent stations. Observatories, automatic monitoring means and expeditions.
- Research of microplastics content in the Arctic environment components
- Organization of unified system of environmental monitoring and database
- Remote sensing of the Earth in the interests of Arctic development
- Monitoring the state and development of approaches to restoration of Arctic ecosystems, biotechnologies
- Metagenomic research of Arctic ecosystems
- Monitoring and conservation of Arctic ecosystems
- Arctic Climate Research
- Research on mechanisms, consequences and perspectives of climate change in the Arctic
- Research of sustainability and productivity of cryolithozone ecosystems under current conditions
- Ecological problems of anthropogenic impact on ecosystems, climatology
- Arctic Climate Change: Rising Average Air Temperature and Melting Ice
- Climate monitoring and space weather research

THEME 2: UNDERSTAND

ENHANCING UNDERSTANDING AND PREDICTION CAPABILITIES OF ARCTIC ECOLOGICAL AND SOCIAL SYSTEMS AND THEIR GLOBAL IMPACTS

- Research of the cryolithic zone in order to ensure the stability of engineering structures in the Arctic
- Comprehensive research of spatial organization of economy and society in the conditions of implementation of the "Arctic vector" of development in the North-East of the Russian Federation
- Development, research of correctness and numerical realization of mathematical models of natural and anthropogenic processes in the Arctic and Northern regions. Development of mathematical methods and their application
- Development of technologies to preserve health and increase life expectancy in the Arctic zone
- Investigation of the socio-economic impact of current processes on the livelihoods of local Arctic residents and indigenous communities
- Research and preservation of historical and ethnocultural heritage of the Arctic peoples
- Health and social well-being of Arctic residents
- Research on demographic and social trends in the development of Arctic indigenous peoples
- Research on fundamental mechanisms of human adaptation to climatic and geographical conditions of the Arctic
- Sustainable development of small-numbered peoples, strengthening their social-economic potential
- Arctic tourism
- Human Health in the Arctic
- Arctic Urbanism
- Transport and logistics in the Arctic
- Research on the causes and mechanisms of climate change in the Arctic. Identification of causes and mechanisms of climate change, assessment of their consequences, solving the problems of adaptation and regulation in conditions of climate change

THEME 3: RESPONSE
SUSTAINABILITY, ASSESSING VULNERABILITY AND RECOVERABILITY, APPLICATION OF KNOWLEDGE

- Creation of new functional and structural materials, development of vehicles for operation in natural and climatic conditions of the Arctic
- Research into the causes and mechanisms of hazardous natural conditions in the Arctic, development of methods and technologies for prognostication of hazardous phenomena
- Research on biodiversity, biological resources and biotechnologies of their use
- Biochemical and physiological adaptations of living organisms, molecular-genetic research of biological objects in the North
- Paleoecological research
- Resource potential assessment of extinct mammoth fauna and anthropogenic impact on it in the Arctic region
- Conservation and restoration of Arctic biodiversity
- Forecasting of risks of exploitation of resources of seas in the Arctic region
- Assessment of probability of toxic substances and dangerous pathogens penetration into the Arctic region
- Assessment of state and dynamics of bio-productivity and bio-diversity of Arctic ecosystems under conditions of climate change and growth of hydrocarbon production and transportation

- Reconstructing Ecosystem and Climate Dynamics in the Arctic in the Quaternary Period
- Technogenic impact on life of Arctic indigenous peoples
- Development of drugs based on biologically active substances of deep-sea hydrobionts
- Analysis of risks of natural and man-made emergencies, as well as adaptation and mitigation measures for population and economy
- Scenarios of industrial and transport infrastructure development in the Arctic region, including places of traditional residence of small peoples and their traditional economic activities
- Research on current changes in the Arctic environment and the factors determining them
- Forecasting of adverse environmental impacts of anthropogenic impact and climate change in the Arctic region
- Assessment of river use conditions in the Arctic region, including the climate change impact on the hydrological regime and hydrological hazards
- Assessment of the Arctic geosystems against the backdrop of continuing climate change and increasing anthropogenic pressures
- Problems of environmental pollution and bioresources research in the Arctic

THEME 4: STRENGTHEN
CAPACITY BUILDING, EDUCATION, NETWORKING, AND RESILIENCE - PREPARING THE FUTURE GENERATION

- Innovative technologies in transport and road construction with rational use of local raw materials and energy saving
- Scientific support of infrastructure projects in the Arctic zone
- New effective functional and constructional materials
- Heat and energy efficiency of buildings in the Arctic and in the North
- Energy efficiency, energy supply and alternative energy sources
- Development of new materials with special properties: polymers and nanomaterials
- Creation of high-precision monitoring and forecasting methods of environmental conditions on the basis of artificial intelligence
- Geophysics, geodynamics of Arctic
- Geocryology (science of permafrost)
- Glaciology
- Marine and river biotechnology
- Biological monitoring
- Chemistry of natural compounds
- Analytical chemistry of environmental objects
- Livelihoods of Indigenous Peoples of the Arctic (transport infrastructure, medicine, education)
- Adaptation of population of Arctic regions to the Arctic environment and climate changes
- Socio-economic issues
- History and ethnography of the Arctic
- Urban Development in the Arctic
- Arctic ethnology; small peoples, their languages and cultures
- Creation of complex numerical and physical-statistical models for diagnosing and forecasting natural conditions and assessing possible changes in the Arctic environment on long-term, seasonal, interannual and extra-long-term (more than a decade) time scales to ensure safe living and effective development of polar regions

THEME 5: DEVELOPMENT

THE USE OF JOINT SCIENTIFIC AND TECHNOLOGICAL AND INNOVATION DEVELOPMENTS IN THE IMPLEMENTATION OF INTERNATIONAL PROJECTS OF THE ARCTIC REGION COUNTRIES

- Development of mathematical models of natural and technogenic processes in the Arctic and Northern regions.
- Formation of reference mineral resource centers in the Arctic zone on the principles of closed-loop economy and development of reconstruction technologies for complex development and deep processing of natural resources
- Scientific support of projects in the field of infrastructure of the Arctic regions
- New materials, renewable energy sources
- Development of scientific basis for human health provision in the North, creation of innovative products and technologies for diagnostics, treatment and prevention of diseases in the Arctic territories
- Consequences of technogenic impact of industrial enterprises on the population of the Arctic zone

- Interdisciplinary Research in Neurobiology
- Development of ecotourism in the Arctic
- Arctic medicine, biomedical research
- Interdisciplinary Research in the Humanities
- Preservation and development of culture, languages, literature of peoples of the North-East of the Russian Federation and other Arctic regions
- Research and actualization of historical and cultural heritage of the peoples of the North
- Legal mechanisms of society and state life support in the northern territories of the Russian Federation and other Arctic countries

ACTIVITIES FOR THE DEVELOPMENT OF RESEARCH AND EDUCATIONAL COOPERATION

280 international research projects in the field of development of scientific and educational cooperation in the Arctic region are currently being implemented. These include:

- Development of scientific cooperation in the Arctic (multilateral research projects) - 64 projects.
- Arctic seas - 24 projects.
- Conservation of biological diversity - 31 projects.
- Native populations and habitats - 32 projects.
- Education - 17 projects.
- Climate changes - 112 projects.

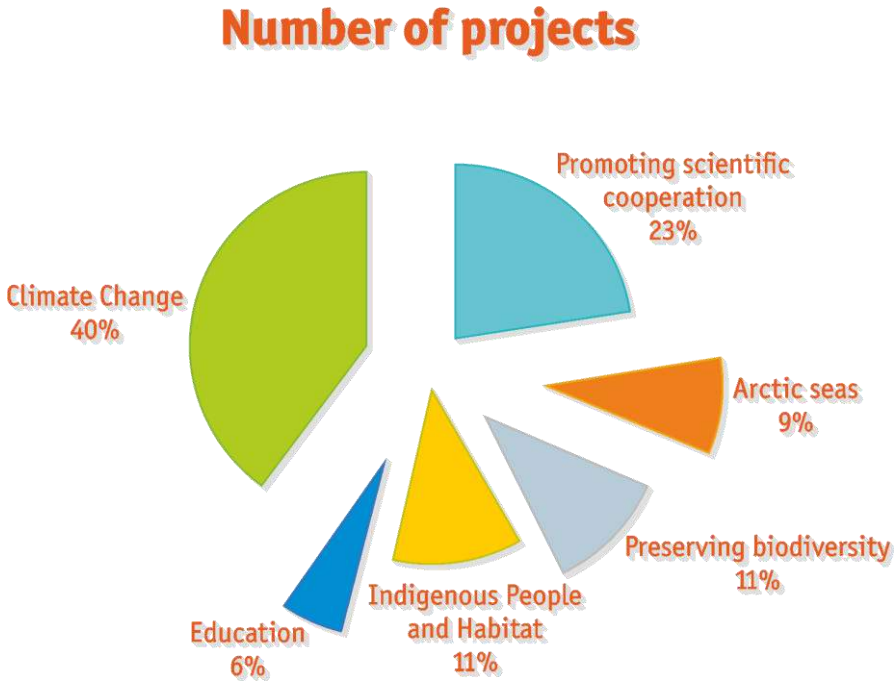

Figure 1: Number of projects
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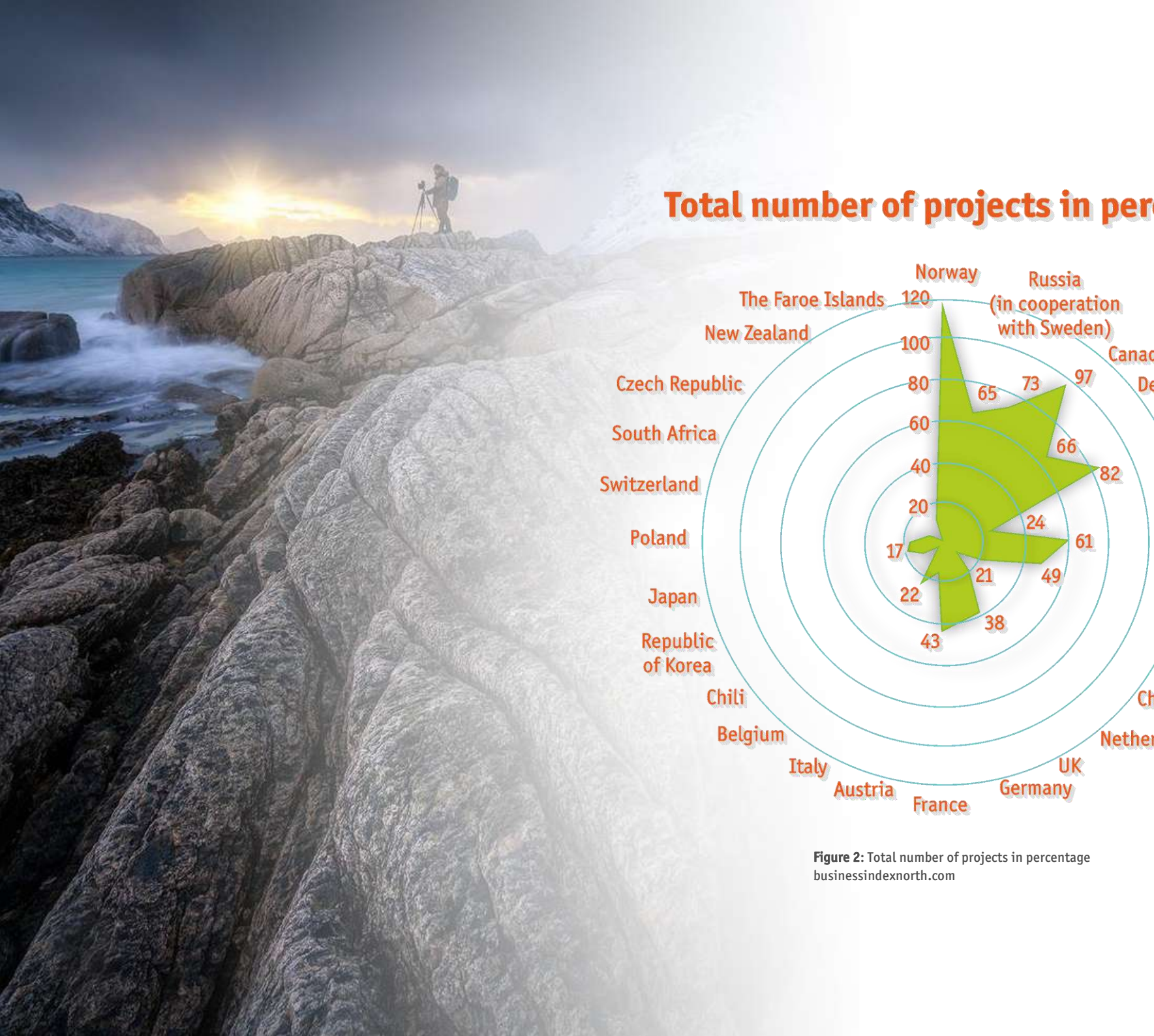

Total number of projects in percentage

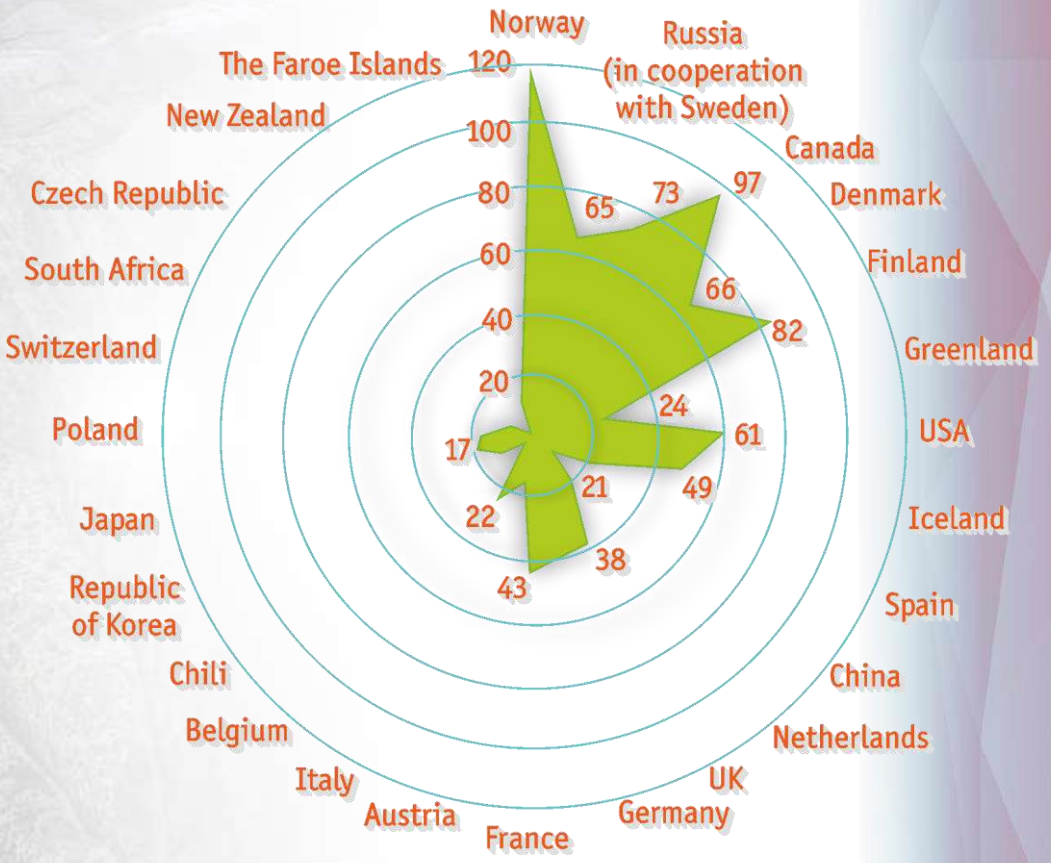

Figure 2: Total number of projects in percentage
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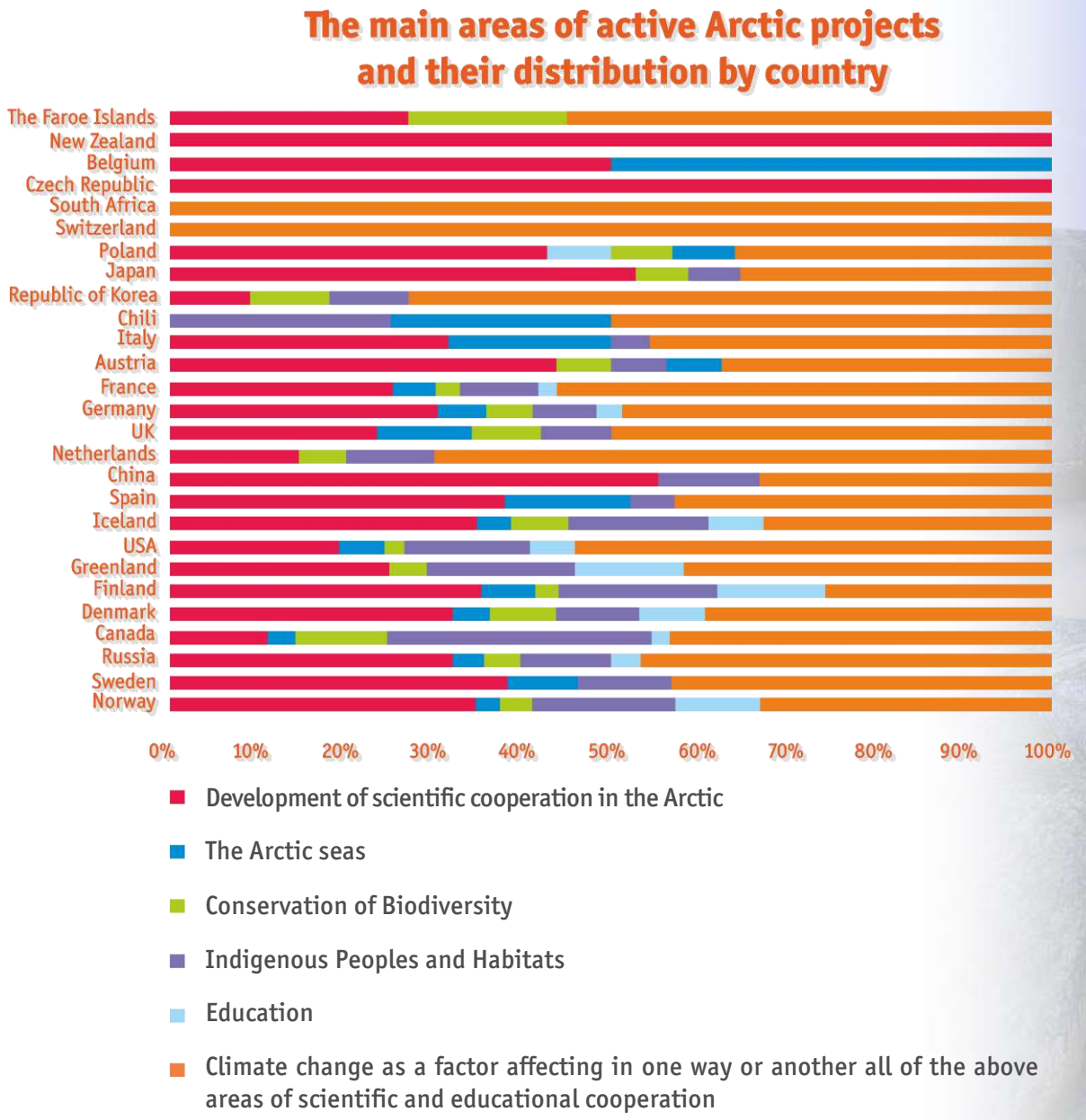

Figure 3: The main areas of active Arctic projects
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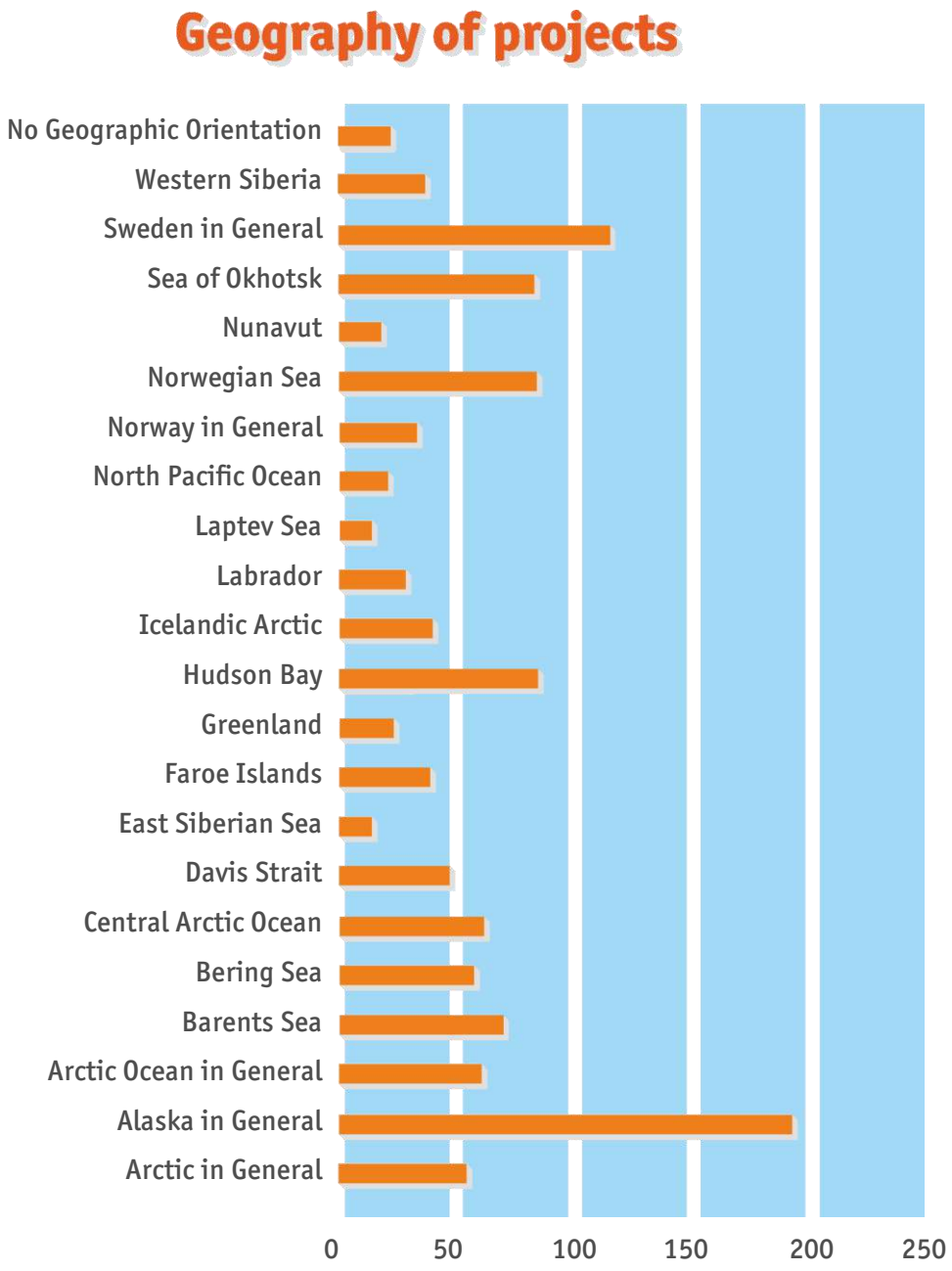

Figure 4: Geography of projects
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THEMES OF ASM PROJECTS

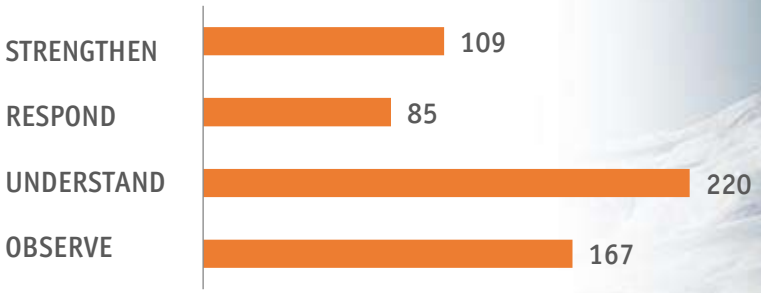

Figure 5: Themes of ASM projects
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TOTAL NUMBER OF PARTICIPANTS IN PROJECTS

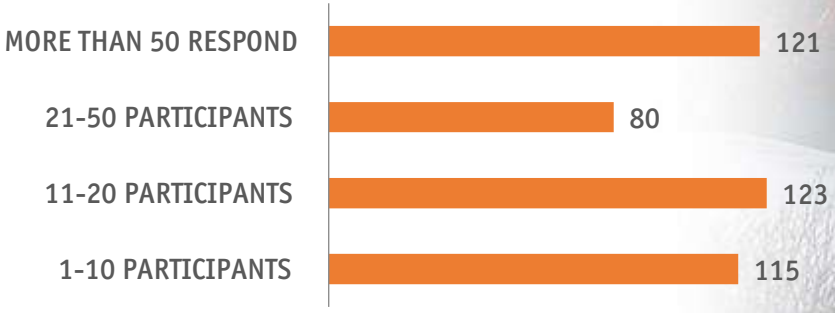

Figure 6: Total number of participants
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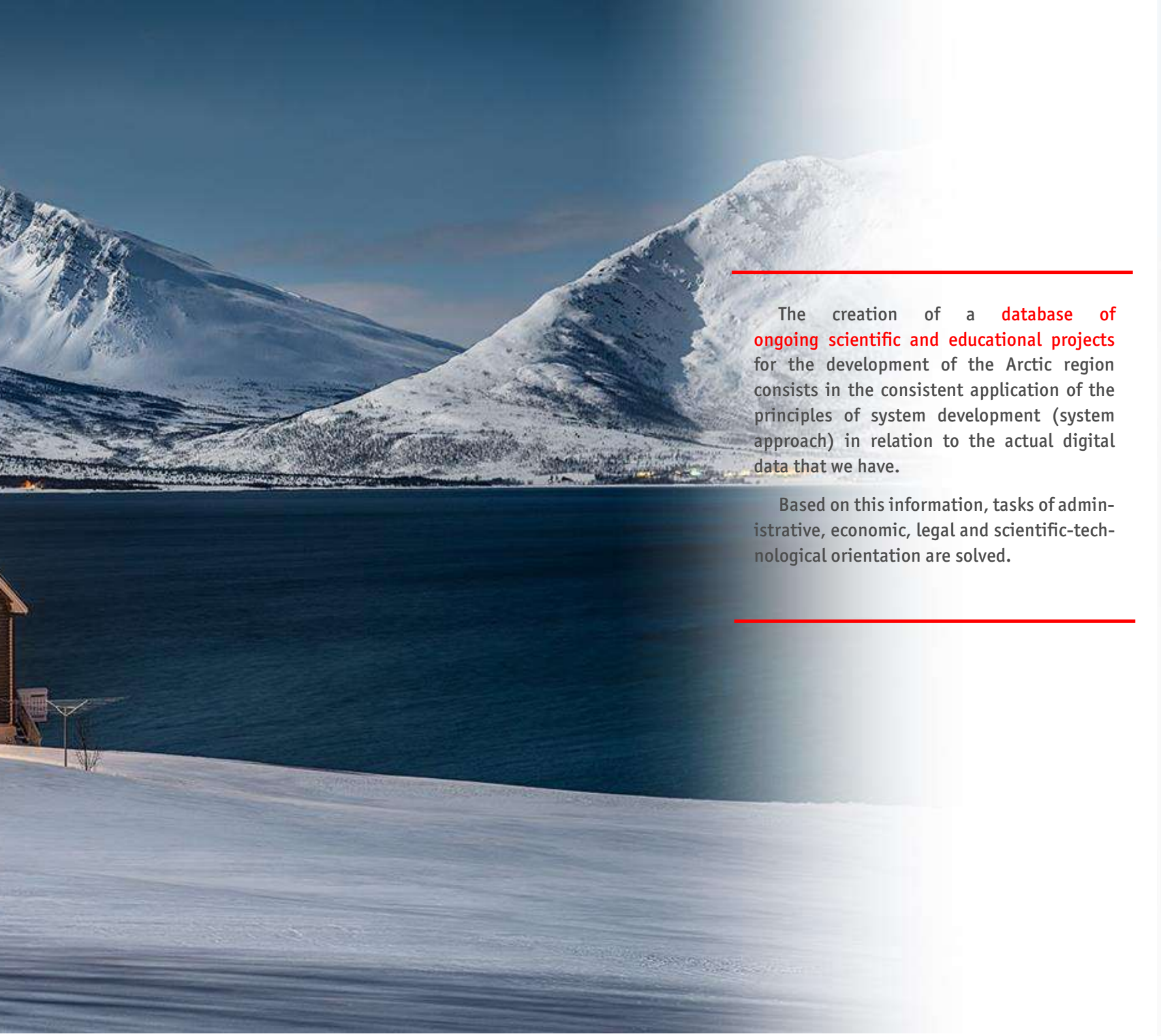
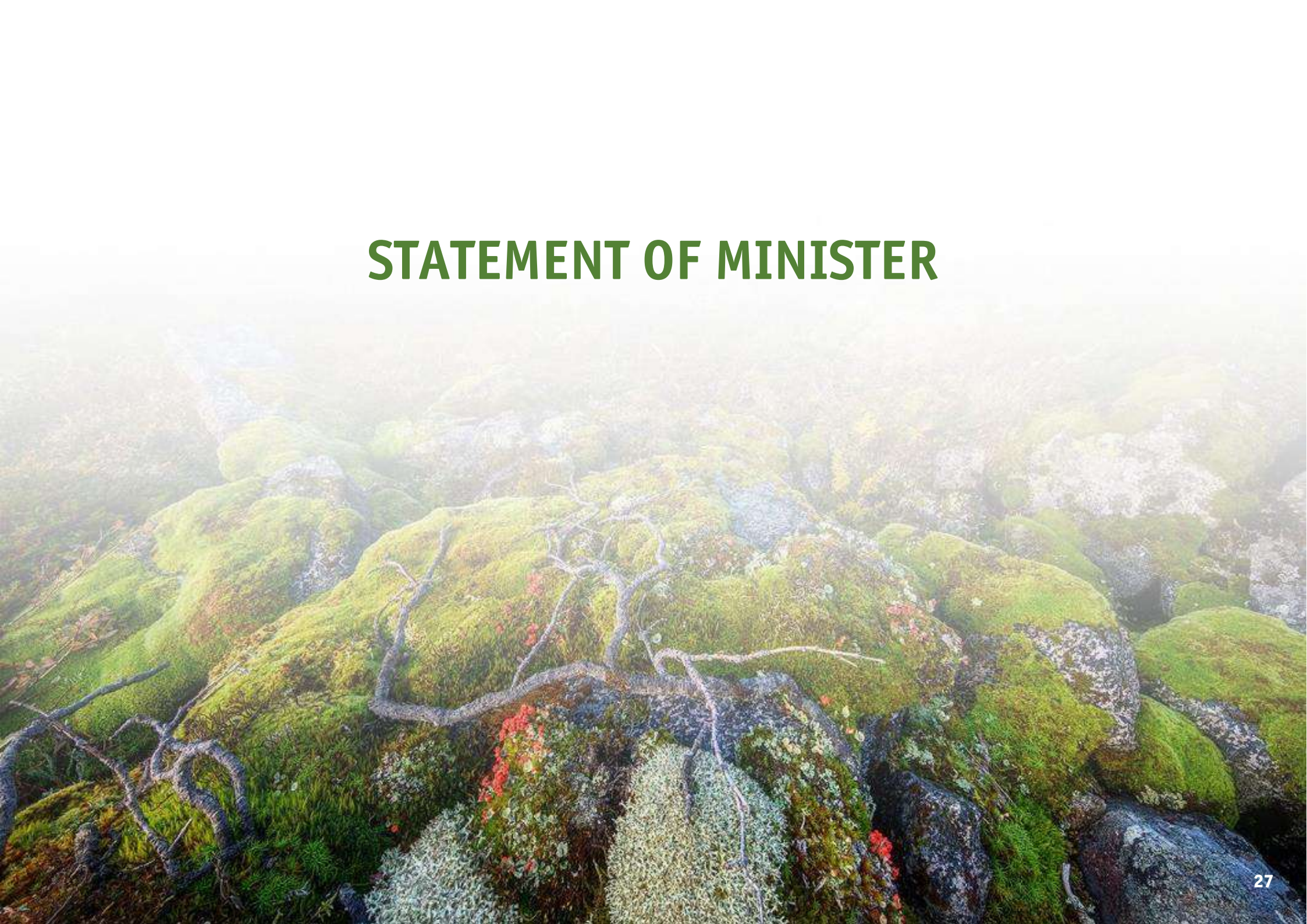


The creation of a **database of ongoing scientific and educational projects** for the development of the Arctic region consists in the consistent application of the principles of system development (system approach) in relation to the actual digital data that we have.

Based on this information, tasks of administrative, economic, legal and scientific-technological orientation are solved.

Photographer: Vasily Iakovlev
Murmansk, Russia

STATEMENT OF MINISTER



STATEMENT OF MINISTER

ON THE OCCASION OF THE FOURTH ARCTIC SCIENCE MINISTERIAL MEETING

Distinguished colleagues, friends of the Arctic!

The Ministry of Science and Higher Education of the Russian Federation, in connection with the Russian Federation's chairmanship of the Arctic Council from 2021 to 2023, acting as the coordinator of the Arctic Science Ministerial (ASM), confirms its intention to support measures to further strengthen international research cooperation to improve knowledge and understanding of the Arctic region, as well as to support solutions aimed at sustainable development of , confirms its intention to support measures to further strengthen international research cooperation to improve knowledge and understanding of the Arctic region, as well as to support solutions aimed at sustainable development of Arctic.

We express our gratitude to the governments of the countries and leaders of organizations sharing the position of the Russian Federation on the need to continue working together for the benefit of the future of the Arctic region and the peoples inhabiting it. We thank the organizers of the previous Arctic Science Ministerial meetings for significant contributions to Arctic cooperation, including recognition of the need for both Arctic and non-Arctic states and representatives of Arctic indigenous peoples to participate, as well as the broad involvement of civil society in the ASM format.

We are holding the fourth Arctic Science Ministerial meeting with a conscious desire to strengthen cooperation and further increase the achieved indicators of joint work for the benefit of the development of the Arctic region. The Russian Federation stands for preserving the Arctic region as a territory of peace, stability and constructive cooperation focused on achieving concrete, practical results in the interests of the entire population of northern latitudes, including indigenous peoples.

Against the background of the global challenges facing humankind today and the ongoing geopolitical changes, the issue of international cooperation and integration, and the relevance and timeliness of scientific and political measures in the Arctic is of particular importance.

We recognize the consistently high contribution to international Arctic scientific cooperation by the Arctic Council, which remains the leading forum in the Arctic region. The reports and assessments of the Arctic Council's working groups play an important role in bringing the region's concerns to the global stage.

Research findings and perspectives from the scientific organizations of the Arctic Council member states are actively considered at international conferences and meetings as part of the plan of major events in connection with the Russian Federation's chairmanship of the Arctic Council in 2021-2023.

We value the inclusiveness and diversity of the global Arctic research community, which brings together the wisdom and experience of traditional Arctic knowledge holders, the energy of youth, and the creativity of a new generation of leaders.

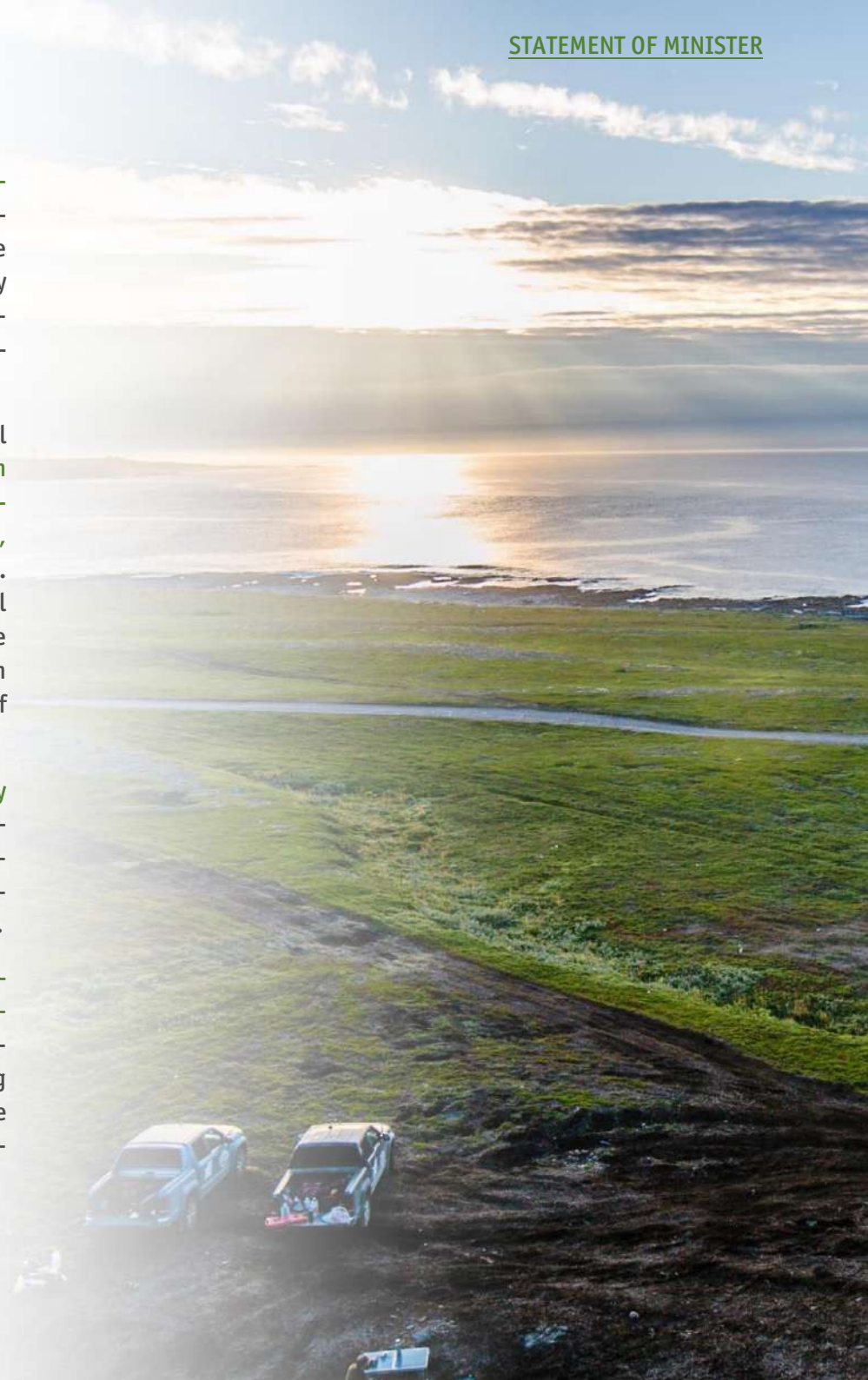
Knowledge systems created and used by Arctic indigenous peoples in the region for thousands of years continue to be built today. This fact emphasizes the importance of constructive engagement and partnerships with indigenous peoples to advance traditional knowledge in international forums and agreements. The symbiosis of traditional knowledge and scientific research into a unified system of knowledge will guarantee reliable, fact-based information. We urge the development of constructive and useful working relationships with indigenous peoples and communities, such as long-term projects, funding mechanisms and tools to help develop relationships, and the use of ethical codes of conduct in polar research, especially those involving or affecting indigenous peoples and their communities.

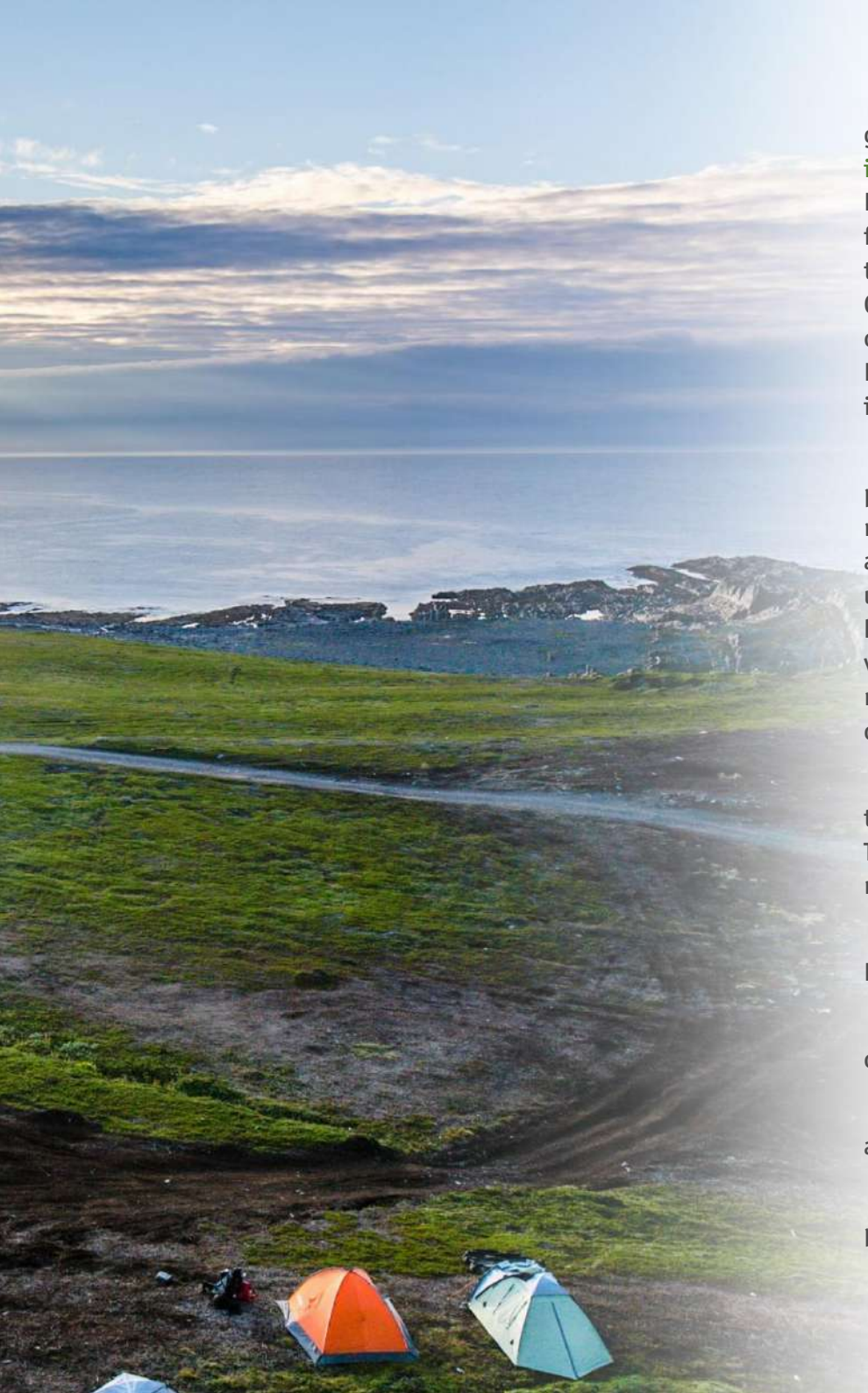
At the present stage, the necessity of solving global environmental problems is deeply realized by the world scientific community. In order to develop common solutions and effective measures for adaptation to climate change, as well as a strategy for prompt response to its consequences, it is important to intensify international scientific cooperation with active promotion of the climate and environmental agenda.

We welcome the recent achievements of the international research community in relation to the Arctic: the UN Decade on Ocean Science for Sustainable Development and Ecosystem Restoration, the International Decade of Indigenous Languages, and the Intergovernmental Panel on Climate Change (IPBES). During this cycle, the IPBES has already released three Special Reports and a Methodological Report on National Greenhouse Gas Inventories. In early August, the third volume of the sixth IPBES Assessment Report on Climate Change on mitigation of anthropogenic impacts on the climate system was completed.

Joint activities of the international research community contribute to the implementation of the 2035 Agenda for Sustainable Development, the UN Framework Convention on Climate Change, the Paris Agreement, the Convention on Biological Diversity and the UN Convention to Combat Desertification.

We welcome the continued implementation of the Agreement on Strengthening Arctic International Scientific Cooperation, which entered into force on 23 May 2018 under the auspices of the Arctic Council, and note its relevance for improving international scientific cooperation. We urge the parties to the Agreement to facilitate the full implementation of its provisions.





We also welcome the ongoing process of ratification of the legally binding Agreement on the Prevention of Unregulated Fishing on the High Seas in the Central Arctic Ocean (ratified by the Russian Federation on 25 June 2021), which, once it enters into force, will facilitate cooperation in scientific activities and the establishment of a Joint Research and Monitoring Program on the Central Arctic Ocean. On 23 November 2022, the first Conference of the Parties to the Agreement opened in Incheon, Republic of Korea. We note the importance of the work done to prepare for its implementation.

The Russian coordination under the ASM focused on topics important for the sustainable development of the Arctic region that require collective efforts of all participants of the Arctic G8, such as the need to improve living conditions of the Arctic Region population, environmental issues, adaptation to climate change in high latitudes, biodiversity conservation, and the economic development of the Arctic accompanied by large-scale projects for mining and processing of natural resources, as well as the growth of tourism and trade.

Solutions for sustainable economic development is the main topic of the Fourth Ministerial Meeting on Science in the Arctic. The Russian side identified FIVE subthemes, which propose measures for international cooperation:

1. Observation: implementation of observation networks. Data exchange

2. Understanding: Improved understanding and forecasting of Arctic ecological and social systems and their global impacts.

3. Responding: Sustaining Development. Assessing Vulnerability and Resilience. Applying Knowledge

4. Strengthening: Training the next generation through capacity building. Education. Networking. Resilience

5. Design: Solutions for Sustainable Economic Development

1. Observation: Introduction of observation networks. Data exchange

As the Arctic suffers from a lack of reliable information about changes within its boundaries, it is necessary to ensure continuous monitoring of natural processes by organizing long-term observations and studying the effects of different kinds of natural and anthropogenic factors on the Arctic zone environment. Maintaining long-term national observing systems requires significant human resources and costs due to difficult logistical conditions. Maintaining a high level of coordinated observations with the use of modern monitoring systems is possible through special experiments on ships, stations and bases, with the use of autonomous observation facilities and space sensing. Interaction with bearers of traditional knowledge and residents of the Arctic plays an important role in creating local observation systems.

Proposed measures: Expansion of interaction of all participants of scientific researches in the Arctic in the process of formation and analysis of world ecological databases of big data sets (BIG DATA) and attraction of methods of remote use of data for interpretation of local processes in the Arctic. The Russian Chairmanship considers the development of joint maritime expedition activities with partners in the Arctic Council perspective. We express our readiness to organize and conduct large-scale high-latitude expedition research with the participation of specialists from foreign research centers. We recognize the need to support and make use of observations by indigenous peoples and communities, and to facilitate the acquisition of joint knowledge.

Russia attaches particular importance to the implementation of the Agreement on Strengthening International Arctic Scientific Cooperation. Considering the complexity of harmonizing existing national regulations for research in the exclusive economic zones of states, we believe it advisable to continue purposeful work on the development of legal mechanisms for the implementation of the Agreement.

2. Understanding: Enhancing the capacity to understand and predict Arctic ecological and social systems and their global impacts

The changes taking place in the Arctic are rapidly affecting the world. Developing effective strategies to mitigate and adapt to their negative impacts requires a good understanding and accurate assessment of current changes, as well as accurate forecasting of future changes.

In November 2021, a "Climate Change Adaptation Plan for the Arctic Zone of the Russian Federation" was approved, including all sectors of the economy, health impacts, biodiversity conservation and support for indigenous peoples.

Proposed Measures: Recognizing the complexity of the system linking all ecological and socio-economic components, Russia supports integrated Arctic research programs and the development of a support mechanism for multilateral research initiatives based on the Russian initiative presented at the Arctic Research Coordination Senior Officials Meeting in Moscow on November 18, 2021 in a hybrid format.

3. Responses: Ensuring Sustainable Development. Assessing Vulnerability and Resilience. Applying Knowledge

The key challenge for the Arctic region is to monitor climate change and its impact on the unique Arctic ecosystems, and to prevent the negative and irreversible consequences of high latitude human activities. The vulnerability and long-term character of the Arctic ecosystems recovery brings to the fore the development of international scientific cooperation in the field of elaboration of highly effective and ecologically safe ways of exploitation of marine and shelf resources and resources of the Arctic terrestrial areas.

Proposed Measures: Continue to study the possible significant increase in methane emissions due to degradation of the shelf permafrost and the role of gas hydrates in the formation of the methane cycle, which could be the subject of study by the Arctic Council expert group on black carbon and methane and the working group on the Arctic Monitoring and Assessment Program. A separate area of cooperation is the study of cryolithozone degradation and related environmental changes, including the carbon balance. A separate area of cooperation is research of cryolithozone degradation and related changes in the natural environment, including carbon balance.

The International Arctic Station Snezhinka (Yamal-Nenets Autonomous Okrug, Russia) can become another platform for cooperation, primarily focused on research in the field of carbon-free energy. Besides, noteworthy are the initiatives of scientific teams of the West Siberian Interregional Scientific and Educational Center of World Level (Tyumen region, Khanty-Mansiysk Autonomous Okrug - Ugra and Yamalo-Nenets Autonomous Okrug, Russia) in the directions of "Biological safety of humans, animals and plants"; "The Arctic: Resources of the "Cold World" and Environmental Quality, Man in the Arctic", as well as the scientific and educational center "North: The Territory of Sustainable Development" (Sakha Republic (Yakutia), Sakhalin Region, Kamchatka Territory, Magadan Region, Chukotka Autonomous District, Russia) in the field "Permafrost Ecosystem Sustainability under Climate Change and Anthropogenic Impacts".

An important and promising area of cooperation is monitoring and assessment of the Arctic region with regard to radioactive pollution, problems of pollution by garbage and microplastics, as well as persistent organic pollutants and mercury, including the process of evaluating the effectiveness of the Stockholm and Minamata Conventions.

A separate area of cooperation should be the improvement of mathematical models of the spread of pollutants, primarily oil and petroleum products, without which reliable forecasting of changes in the Arctic environment under the influence of human activity is impossible.

Russia supports work of scientific experts of countries-participants of the Agreement on the Prevention of Illegal Fishing in the High Seas of the Central Arctic Ocean on research of condition and management of living aquatic resources in the zone of the Agreement. In particular, there are plans to conduct phylogeographic and genomic research of poorly studied groups of hydrobionts in the Arctic.

4. Strengthening: Training the next generation through capacity building. Education. Networking. Capacity for recovery

The Russian Chairmanship aims at improving the efficiency of scientific activities and the practical applicability of their results in the Arctic. We aim to optimize use of scientific infrastructure, and promote advanced technologies and best practices in implementation of joint projects.

Proposed Measures: To develop approaches and principles for long-term coordinated programs in basic and applied research.

Joint work within the framework of Arctic economic development will make it possible to identify the highest priority areas of activity of the Arctic region countries and trace progress, and identify the challenges and additional needs to achieve their common goals. This information will be useful in discussions at subsequent workshops, meetings, and joint projects.

5. Development: Solutions for sustainable economic development

Coordination of research programs will increase the efficiency of scientific work, optimize the use of scientific infrastructure, and utilize advanced technologies and practices of the Arctic Council member countries. Improving the efficiency of scientific activities and the practical applicability of their results in the Arctic by optimizing the use of scientific infrastructure, promoting advanced technologies and best practices in the implementation of joint projects.

Proposed measures: implementation of international projects of the Arctic region countries using joint scientific, scientific-technical and innovative developments, as well as educational programs to improve the efficiency of key sectors of national economies.

Forum of Arctic science funders

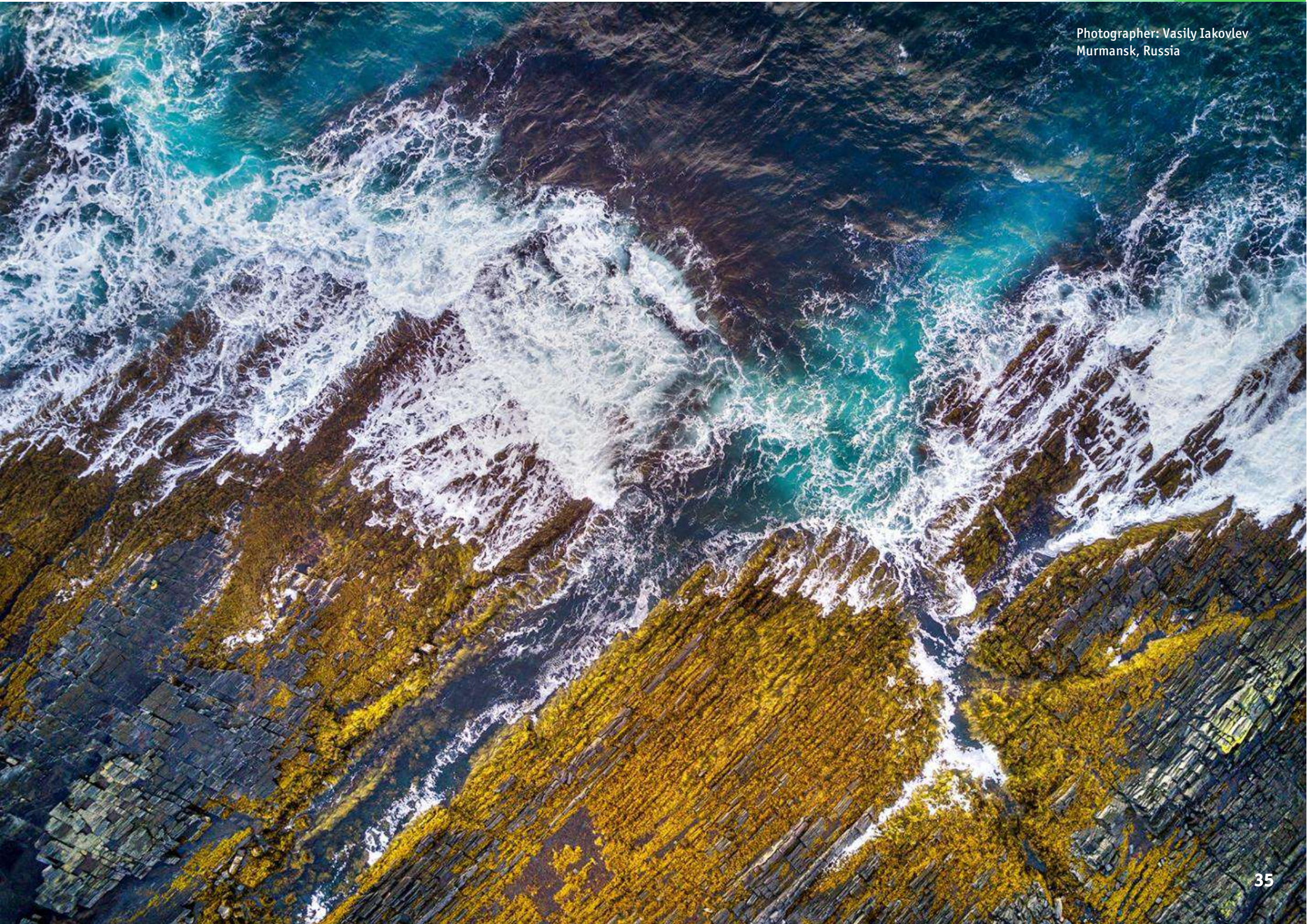
The Arctic Science Funders Forum was formally established through the initiatives of the Second Ministerial Meeting on Arctic Science Cooperation on March 30, 2020. We encourage the Arctic Science Funders Forum to promote and facilitate international cooperation by taking into account the recommendation of the Third Ministerial Meeting on Arctic Scientific Cooperation.

CONCLUSION

Through our concerted actions at the Fourth Arctic Science Ministerial Meeting, we demonstrate the importance that governments of Arctic and non-Arctic states, as well as Arctic indigenous peoples' organizations, place on supporting international and multilateral cooperation in science, research and knowledge to achieve sustainable development of the Arctic.

MINISTER OF SCIENCE AND HIGHER
EDUCATION OF THE RUSSIAN FEDERATION

V. FALKOV



Photographer: Vasily Iakovlev
Murmansk, Russia

Photographer: Vasily Iakovlev
Russia

ARCTIC RESEARCH OVERVIEWS

ARCTIC RESEARCH OVERVIEWS

Initially, it was announced that ASM4 would be prepared by Russia and France. After the suspension of French participation Russia decided to continue the commitment on its own. The information included in this report on countries that were not able to submit national reports by the end of January 2023 was taken from publicly available sources.

This report provides an overview of completed and ongoing projects and activities that represent the scientific base of ASM member countries. The main purpose of this information is to share scientific experience in organizing research in the Arctic and to generate information to support activities in science and higher education through the work of international organizations and forums in the Arctic zone, and to maintain and update a database on research projects in the Arctic, carried out by scientific and educational organizations, including jointly, and through the work of international organizations.

The information base for this work was the results of evaluation of feedback from Russian and foreign scientific and educational organizations, data on international projects in the Arctic, and materials from the websites of the Arctic Council https://arctic-council.org/ and the working groups of the Arctic Council. In addition, climate, geological, biological, sociological and technological research is used as the basis for developing strategies for sustainable economic development of the Arctic, which take into account the interests of all stakeholders, including indigenous peoples, environmental organizations, industry and government agencies.

Photographer: Anton Vasiliev
Russia

AUSTRIA

POLAR ECOLOGY

Austria aims at providing fundamental understanding of the evolutionary, genetic, and ecological adaptations of organisms and communities in polar (marine, terrestrial, and ice/snow) environments and the role polar ecosystems play in global biogeochemical cycles and potential feedbacks to climate changes.

One focus is on polar microbiology and biogeochemistry, since the dominant life forms in extreme polar environments are microorganisms. Microorganisms adapt rapidly, comprise the bulk of polar biodiversity, and are actively involved in the cycling of carbon and other elements such as nitrogen and sulfur. Polar regions are most strongly influenced by global change, leading to dramatic shifts in microbial community composition and activity.

Another focus is on the vulnerability of the vast amount of organic carbon stored in arctic permafrost soils. Permafrost soils and sediments harbor about twice as much carbon than the atmosphere; global change, such as increasing temperatures or nitrogen deposition are thus expected to accelerate microbial decomposition of soil carbon, with unknown feedbacks to the climate.

CRYOSPHERE & CLIMATE

The reaction of the polar cryosphere to climate change is a key focus in climate research. Major research topics of APRI on polar ice and climate are the response of grounded ice to the disintegration of northern Larsen Ice Shelf at the Antarctic Peninsula, paleo-temperature interpretation from ice cores in Antarctica with respect to meteorological influences on the relationship between stable water isotopes and air temperature, the energy- and mass balance of glaciers in NW-Svalbard and NE-Greenland from extensive ground observations and modelling approaches as well as the mechanism of glacier outburst floods in NE-Greenland.

Further research encompasses the monitoring of snow and permafrost associated surface features such as thaw lakes and soil water state (frozen/unfrozen).

APRI research is located both in the Arctic and in Antarctica with a broad field of applied methods covering satellite techniques, ice core interpretation, geophysical measurements as well as detailed ground observations of surface energy- and mass balance.

SOCIAL & CULTURAL SYSTEMS

Indigenous peoples have inhabited the arctic and subarctic regions for millennia. In recent centuries, the colonial reach of southern states and empires has changed the political and demographic situation of these regions significantly. Even more recently, economic migrants from the Global South have started to move north, contributing to the colorful ethnic and cultural mosaic that characterizes the “New North”.

Climate change brings about new challenges and opportunities: the receding sea ice threatens traditional subsistence activities, while new resource development becomes possible, to name just a few effects. Given that it is people who make decisions about human-environmental interactions in the North, the scientific study of arctic and subarctic social and cultural systems is imperative.

Photo: www.era.gv.at

Photo: www.era.gv.at

The field of arctic social sciences works in close collaboration with the humanities and natural sciences, in order to address present and future issues and problems of the North.

Austria has no funding program particularly focusing on polar regions.

However, several funding institutions are open to arctic research proposals.

The Austrian Academy of Sciences (ÖAW), which runs specific calls for pro- posals e.g. to Earth System Sciences ESS open for topics of Arctic research.

The Austrian Science Fund (FWF) is the main funding organization for basic research in Austria and is open for all disciplines of research.

The Austrian Research Promotion Agency (FFG), is the main funding organization for applied research, and has a specific program for space research including remote sensing.

The Federal Ministry of Education, Science and Research, which supports research within the framework of global budgeting of the universities and specific programs e.g. Sparkling Science, is tailored to promote research-education cooperation.

Institutions of Arctic research (universities, Austrian Academy of Sciences, weather service ZAMG, enterprises) are coordinated via the Austrian Polar Research Institute (APR).

Resource information:

www.fwf.ac.at
www.oeaw.ac.at
www.ffg.at
www.era.gv.at

BELGIUM

BELGIUM

The Belgian Science Policy (BELSPO) and the Fonds National de la Recherche Scientifique (FNRS) represent Belgium at the European Polar Board.

Beligium participates at polar view (pV), an initiative by the European Space Agency (ESA) and the European Commission, with participation from the Canadian Space Agency, under the Copernicus programme. Current PV service lines include: Sea Ice Monitoring and Forecasting; Iceberg Monitoring; Ice Edge Monitoring; Ice Drift Trajectories; River Ice Monitoring; Lake Ice Monitoring; Glacier Monitoring; Snow Monitoring.

International Polar Foundation is recognized by the Belgian Royal Statute as a foundation for public good. The International Polar Foundation supports polar scientific research for the advancement of knowledge, the promotion of informed action on climate change, and the development of a sustainable society.

Fonds voor Wetenschappelijk Onderzoek - Vlaanderen (FWO) [en. Research Foundation Flanders] supports fundamental scientific research, stimulates international cooperation and promotes equal opportunity.

SELECTED EU-FINANCED PROJECTS

The Flemish Institute for technological research, Belgium is partner to CoreClimax, a project for Coordination the identification of essential climate change variables and the creation of long term climate data records. CoreClimax is partially financed by the EU by the 7th Framework Programme.

Universite Libre de Bruxelles, Belgium is partner to EPOCA (European Project on Ocean Acidification) a project for Advancing the understanding of the biological, ecological, biogeochemical, and societal implications of ocean acidification. EPOCA is partially financed by the EU by the 7th Framework Programme.

Universite de Liege, Belgium is partner to JOULES (Joint Operation for Ultra Low Emission Shipping), a project to Significantly Reducing the gas emissions of European Built ships. JOULES is partially financed by the EU by the 7th Framework Programme.

The expertise of Belgian researchers covers a wide range of topics in the fields of marine, terrestrial and freshwater biology, biogeochemistry and geophysics, glaciology, geology, hydrodynamics, climatology and human biology and medicine.

Some glaciology highlights:

- Contribution of polar researchers (ULB, VUB, Uliège) to the contribution of the Antarctic and Greenland ice sheets to future sea level rise
- Contribution to IPCC AR6
- Multi-million year old record of Greenland vegetation and glacial history

During the first year-around expedition studying the Arctic Climate System (MOSAiC, 2019), Belgian researchers have investigated the role of the Arctic pack ice into the regulation of greenhouse gas circulation and its impact on the distribution of Arctic fish.

Photo: www.eupoliticalreport.eu

Belgium has a long tradition of polar research, dating back to 1897. The Belgian Antarctic expedition on board of the sailing ship the Belgica, led by Adrien de Gerlache, was the first purely scientific international expedition to the region, and also the first one that overwintered, collecting year-round meteorological observations, setting the basis for a better understanding of the Antarctic environment. A few years later, between 1905 and 1909, de Gerlache undertook three major expeditions in the Arctic Ocean, stretching as far as Nova Zembla, Iceland, and Greenland.

Photo: www.esa.int

Resource information:
www.eupoliticalreport.eu
www.arcticinfo.eu

CANADA

CANADA

PRIORITIES OF CANADA INCLUDE:

1. Development for the people of the North.
2. Mental wellness in Arctic communities.
3. Integrating Indigenous knowledge of Arctic peoples into the work of the Council.
4. Environmental protection, including the reduction of black carbon and methane.

KEY ACCOMPLISHMENTS INCLUDE:

1. Canada aided in the establishment of the Arctic Economic Council, an independent forum for business-to-business cooperation.
2. Canada heavily aided in the development of an action plan to prevent oil pollution in the Arctic.
3. An Arctic Council Framework for enhanced black carbon and methane emissions reductions.
4. Assisted in the establishment of the open-access archive project to enhance the public's accessibility to the Arctic Council's work.

CANADA supports scientific research and the integration of the knowledge gained into policy decisions, including those on the Arctic. Equally import- ant is the need to work in partnership with Inuit and other Indigenous and northern communities to set the Arctic research agenda and support their self-determination in research. As outlined in its Arctic and Northern Policy Framework, Canada's approach recognizes the importance of international collaboration to address opportunities and challenges in the Arctic, such as climate change, environmental protection and social inequities. Supporting knowledge creation and evidence-based decision-making as essential pillars of sustainable growth and environmental stewardship is particularly relevant in the Arctic.

MAIN ACTIVITIES

1. Consider the development and dissemination of reports and other information that support navigational safety and environmental protection in the Arctic along the lines of the Arctic Navigation Risk summary bulletin issued by the ARHC in 2017

2. Review the potential interoperability of databases (including the ASTD System) that contain Arctic geospatial information to determine their potential utilization across platforms for improved analysis

3. Undertake work to issue a 2023 update of ARHC's 2018 Arctic hydrography risk assessment by designating a PAME representative to communicate with the ARHC on the approach, structure, usability and other aspects of the update

Collaboration with the Arctic Regional Hydrographic Commission (ARHC)

SAO-approved Memorandum of Understanding signed by PAME and the Arctic Regional Hydrography Commission (ARHC) in 2020, the two bodies developed a joint policy statement on the importance of hydrography in the Arctic region to safe and sustainable maritime navigation.

The statement is inspired by a statement on hydrography issued by the Antarctic Treaty Contracting Parties in 2019. It was approved at the 2021 Arctic Council Ministerial Meeting.

The policy statement contains two principal components:

- First, it recommends that the Arctic States review, update, and improve existing, and collect new, bathymetric and hydrographic data in the Arctic Region.
- Second, it encourages these governments to find additional resources to strengthen hydrographic surveying and charting in the Arctic region. The policy statement identifies several ways each of these recommendations may be pursued.

Further PAME Collaboration with the Arctic Regional Hydrographic Commission (ARHC)

In the PAME 2021-2023 Work Plan, further collaboration between PAME and the ARHC is one of the activities of PAME's shipping work. The two bodies intend to foster greater communication in line with the non-binding MOU between these two bodies to support Arctic maritime safety and the protection of the Arctic marine environment.

PAME and the ARHC intend to:

- Consider the development and dissemination of reports and other information that support navigational safety and environmental protection in the Arctic along the lines of the Arctic Navigation Risk summary bulletin issued by the ARHC in 2017;
- Review the potential interoperability of databases (including the ASTD System) that contain Arctic geospatial information to determine their potential utilization across platforms for improved analysis;
- Undertake work to issue a 2023 update of ARHC's 2018 Arctic hydrography risk assessment by designating a PAME representative to communicate with the ARHC on the approach, structure, usability and other aspects of the update.

BLACK CARBON EMISSIONS FROM SHIPPING ACTIVITY IN THE ARCTIC AND TECHNOLOGY DEVELOPMENTS FOR THEIR REDUCTION

Strengthening harmonization and fostering dialogue and cooperation between the Arctic Council member states, Permanent Participants and Arctic Council Observers on research on various fuel and exhaust gas treatment methods as possible means by which to reduce the amount of harmful gases emitted by vessel engines.

Photographer: Mike Dempsey, the CCGS Louis s. St-laurent, Canada's flagship icebreaker

Resource information:
www.arctic-council.org
www.the-pigeon.ca

CZECH REPUBLIC

THE CZECH REPUBLIC

The Czech Republic remains committed to the Arctic as a region of peaceful coexistence open to scientific research and as a region that brings states and its people together in preventing and combatting negative impacts of climate change, and Czech scientific community shall continue their research activities.

The Czech Republic has a long tradition of Arctic research - Czech scientists operate an Arctic Research Station in Svalbard and they are involved in number of long-term research projects focused especially on the environment, climate change and related sociological and economic issues.

For many years, Czech representatives have participated in the activities of the International Arctic Science Committee (IASC), an advisory body to the Arctic Council.

Czech experts have also been actively involved in the work of the University of the Arctic (UArctic), the Forum of Arctic Research Operators (FARO), the Association of Polar Early Career Scientists (APECS), the International Science Initiative in the Russian Arctic (ISIRA), the US National Science Foundation (NSF), Arctic-FROST, the Arctic-FROST Network, the Interagency Arctic Research Policy Committee (IARPC), the International Network for Terrestrial Research and Monitoring in the Arctic (INTERACT), EU-PolarNet, and more. The Czech Republic wishes to support the work of the Arctic Council through partnerships and cooperation with its Members, Permanent Participants and Observers.

The University of South Bohemia in České Budějovice has concluded a Memorandum of Understanding with Université Laval (Canada) and the Agreement on Cooperation in Polar Research with the Japanese National Institute for Polar Research. Exploratory discussions have also been held with the University of St. Petersburg.

The University of South Bohemia in České Budějovice and Masaryk University in Brno, together with the Austrian Institute for Polar Research and the Polar Research Committee of the Polish Academy of Sciences, have formed the so-called "Central European Polar Partnership". With respect to the activities of the Czech Research Station in Svalbard, the CPE maintains very close relations with the Norwegian Polar Institute, the University Centre in Svalbard (UNIS) and the Arctic University of Norway in Tromsø (UiT).

The Centre for Polar Ecology (CPE) is in the department of the Faculty of Science, University of South Bohemia in České Budějovice. The main purpose of the CPE is ensuring regular university courses in Polar Ecology and similar science topics. In detail, the Centre is focused on extreme environment biology including microbiology- algology, botany, zoology- parasitology, physiology and molecular biology. The second research focus is covered by the collaboration of institutions in the Czech Republic including the Polar-Geo-Lab, Department of Geography, Masaryk University where research on the physical geography of Arctic regions including climatology, glaciology, geology, geomorphology and hydrology are conducted.

Research activities in the Arctic are part of the large infrastructure project Czech Polar Research Infrastructure that overarches both Arctic and Antarctic research.

Photo: Czech Arctic Research Station/www. eu-interact.org

Technical equipment consists of instruments and technologies of the life science laboratories of Centre for Polar Ecology (CPE in České Budějovice), The Czech Arctic Josef Svoboda Station and its research station JULIUS PAYER HOUSE (78.22°N, 15.66°E) which is located in Longyearbyen and provides housing for 10 people (up to 20 for short-term accommodation) complete with kitchen and bathroom (including a shower, washer and drier).

There are two life science laboratories equipped with state-of-the-art optical microscopes, sterile space (laminar flow cabinet, dry heat and infrared sterilizers), centrifuges, etc. The Czech Arctic Josef Svoboda Station also consists of the field camp NOSTOC and the research vessel CLIONE. The Czech Polar Research Infrastructure is wellequipped (considering the financial framework) for basic field and laboratory life science research (Centre for Polar Ecology in České Budějovice). An integral part of the program is equipment to provide scientific multidegree education of students and services from the wide portfolio, e.g. sample collecting, storage and processing; data collecting (i.e. the services provided by the Open Access Data Unit of the research infrastructure); or life science research basic analyses (microscopy, dissection, physiological measurements, manipulation experiments, etc.).

For general logistical purposes, the Czech infrastructure has several means of transport in the field: a research vessel, several rubber boats, an off-road car, all-terrain vehicles, snowmobiles, diving equipment, etc.

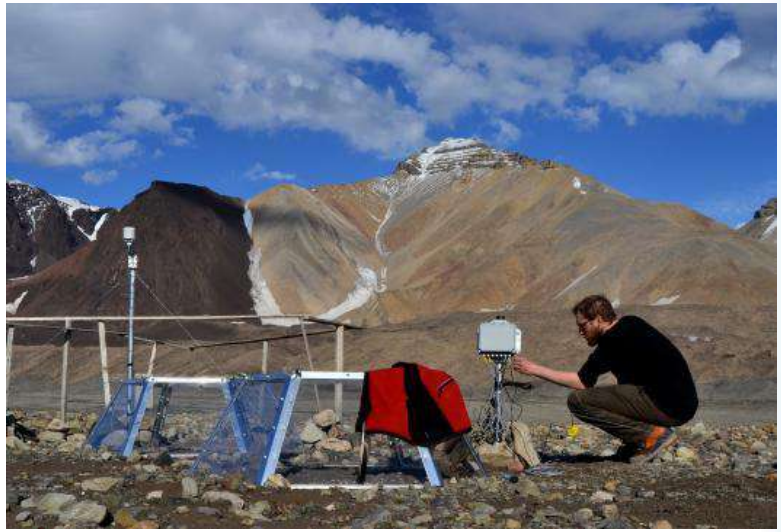


Photo: Experimental boxes in Svalbard, in which Czech scientists study Arctic warming ©CPE Archive

Ministry of Education, Youth and Sports. As a main science-funding national body the Ministry administers a number of funding programs. Funding is available basically on competitive grounds, where long-term infrastructure projects that provide services for diverse kinds of scientific research areas are evaluated once in 3-4 years and the provision of funding is dependent upon past results.

Resource information:

www.mzv.cz

www.eu-interact.org

DENMARK

THE KINGDOM OF DENMARK IN THE ARCTIC REGION

The Kingdom consists of three parts – Denmark, Greenland and the Faroe Islands – and, by virtue of Greenland is centrally located as a coastal state in the Arctic, this involves specific rights and obligations in the region. Today, both Greenland and the Faroe Islands have extensive self-government.

The three parts of the Realm share a number of values and interests and all have a responsibility in and for the Arctic region.

In an equal partnership between the three parts of the Danish Realm, the Kingdom of Denmark speaks with one voice in the Arctic Council.

DENMARK is the southernmost of the Scandinavian countries, and consists of a peninsula, Jutland and an archipelago of 443 named islands, with the largest being Zealand, Funen and the North Jutlandic Island. Over 5.8 million people lives in Denmark. Denmark, Greenland and the Faroe Islands are equal entities within the Kingdom of Denmark. The Self-Government Arrangements transfer political competence and responsibility from the Danish political authorities to the Greenlandic and Faroese authorities. The Danish Government constitutionally conducts Foreign and Security policy of the Kingdom of Denmark in close cooperation with the Governments of Greenland and the Faroe Islands. The Danish Armed Forces undertake important tasks in the Arctic including the enforcement of sovereignty.

THE KINGDOM OF DENMARK IN THE ARCTIC COUNCIL

The Kingdom of Denmark's Chairmanship of the Arctic Council in 2009 – 2011 was an important priority for Denmark, Greenland and the Faroe Islands. At the Ministerial Meeting in Nuuk in 2011, the Nuuk Declaration was adopted, which among other things determined the role and criteria for admission of new observers, established a permanent secretariat for the Arctic Council in Tromsø, Norway, set up a task force to develop an instrument for preventing and managing potential oil spills in the Arctic and mandated an enhanced communication effort of the Arctic Council.

Furthermore, the Ministers signed an agreement on search and rescue in the Arctic (SAR), which as the first legally binding agreement under the auspice of the Arctic Council added a new dimension to the Council's work.

The Kingdom and its populations have developed modern and sustainable societies based on democratic principles. The development has affected all sectors of society - from education, health and research to the environment, trade and shipping. At the same time, huge and sweeping changes are taking place today in the Arctic. Due to climate change and technological developments, vast economic potential is becoming more accessible.

With new opportunities come new challenges. The Arctic has to be managed internationally, based on international principles of law, to ensure a peaceful, secure and collaborative Arctic.

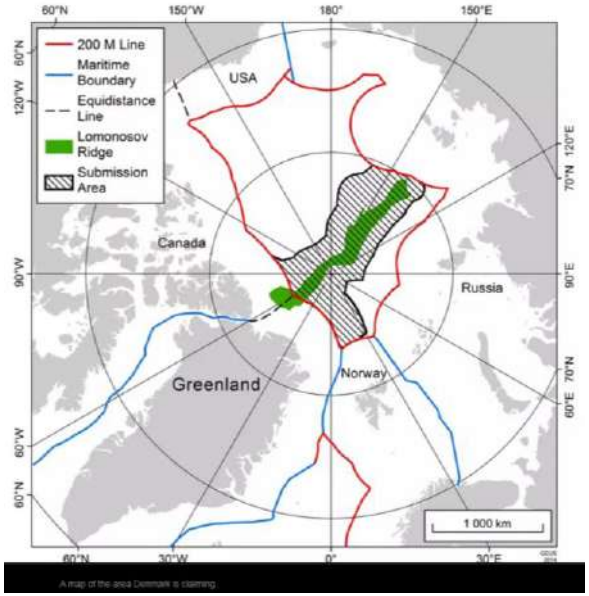


Photo: www.arctic-council.org

The Kingdom is already a vigorous and important actor in the strategically vital international cooperation on the future of the Arctic and in that connection attaches great importance to creating transparency in and understanding for cooperation.

In the Kingdom's strategy for the Arctic 2011-2020, the Governments of Greenland, the Faroes and Denmark have set out the most important opportunities and challenges. On that basis, we have defined our common political objectives for the Arctic.

We will – through close cooperation in the Kingdom and with our international partners - work towards the common overall goal of creating a peaceful, prosperous and sustainable future for the Arctic.

The Governments of Greenland, the Faroes and Denmark are currently working on a new strategy for the Arctic for the period 2021-2030.

Photo: www.arctic-council.org

Resource information:
www.arctic-council.org

EUROPEAN UNION

THE EUROPEAN UNION IN THE ARCTIC

The European Union has an important role to play in supporting successful Arctic cooperation and helping to meet the challenges now facing the region.

THE EU'S ARCTIC POLICY

A SAFE, STABLE, SUSTAINABLE, PEACEFUL AND PROSPEROUS ARCTIC

We believe that a safe, stable, sustainable, peaceful and prosperous Arctic is important not just for the Arctic itself, but for the EU and the entire world. While the Arctic states hold the primary responsibility for tackling issues within their territories, many of these issues do not respect borders, and regional or multilateral cooperation can effectively address them.

The EU's updated Arctic policy, published on October 13, 2021, aims to help preserve the Arctic as a region of peaceful cooperation, to slow the effects of climate change, and to support the sustainable development of Arctic regions to the benefit of Arctic communities, not least Indigenous Peoples, and future generations.

The implementation of the EU's Arctic policy will help the Union to deliver the targets defined by the EU Green Deal and meet its geopolitical interests.

SUSPENSION OF REGIONAL COOPERATION WITH RUSSIA

The EU has joined member states and key like-minded partners in suspending Russia and Belarus from the activities of various regional cooperation frameworks in response to Russia's unprecedented military aggression against Ukraine and the involvement of Belarus in this unprovoked and unjustified aggression. The EU issued three joint statements regarding the Northern Dimension policy; Barents Euro-Arctic cooperation; and the Council of the Baltic Sea States.

NOTE: The EU takes the view that cooperation on Arctic matters with like-minded interlocutors, in relevant bodies and via suitable channels should be carried forward.

SUSTAINABLE DEVELOPMENT IN THE ARCTIC

STIMULATING AN INNOVATIVE GREEN AND BLUE TRANSITION

The EU Green Deal gives the Union a roadmap to ensure a robust green and blue transition both at a global level and in the Arctic. The EU will stimulate change in a number of key areas, including carbon-neutral energy, hydrogen, sustainable extractive industries, e-based learning, e-health, connectivity and infrastructure, sustainable tourism, green technologies, fisheries and agriculture. The EU will push for oil, coal and gas to stay in the ground, including in Arctic regions.

CLIMATE CHANGE IN THE ARCTIC

MAKING THE ARCTIC MORE RESILIENT TO CLIMATE CHANGE AND ENVIRONMENTAL DEGRADATION

The EU recognises its own impact on the Arctic regions. It will tackle this impact in a coordinated manner, in close cooperation with national, regional and local authorities, and Arctic communities. The EU will act against major sources of pollution affecting the Arctic regions in the air, on land and at sea, such as plastics/marine litter, black carbon, chemicals, and transport emissions as well as unsustainable exploitation of natural resources.

PRESERVING THE ARCTIC MARINE ENVIRONMENT PREVENTING UNREGULATED HIGH SEAS FISHERIES

The entry into force of the International Agreement to Prevent Unregulated Fishing in the High Seas of the Central Arctic Ocean is a vital step to protecting the unique richness of the Arctic waters. Signed in 2018 by the EU, Canada, Iceland, Denmark, Norway, USA, China, Japan, South Korea, and Russia, the agreement will commit the parties to not authorize any vessel flying its flag to engage in commercial fishing in the high seas portion of the central Arctic Ocean

THAWING PERMAFROST

PROTECTION OF THE WELL-BEING OF ARCTIC COMMUNITIES

Permafrost is ground below surface that has been frozen for at least two consecutive years and in most cases, for hundreds or thousands of years. As global temperatures rise, permafrost thaws, releasing greenhouse gases that threaten to cause irreversible changes in the Arctic and other regions. Gaining more knowledge on this phenomenon is essential because over 70% of Arctic infrastructure and 45% of oil extraction fields are built on permafrost. In addition to black carbon, thawing permafrost risks to release pathogens, such as anthrax, or contaminants like mercury.

The EU will improve knowledge of this process, using satellite observation and measurements from aircraft, ships and ground stations. Further research is needed to develop adaptation and mitigation measures and increase knowledge of the impact on communities and sustainable development. The EU already supports these activities under Horizon 2020 in the Nunataryuk project, and in the Arctic Passion project. These projects will monitor and forecast permafrost thaw and map permafrost parameters using Copernicus satellites and in situ observations, including data provided by indigenous groups.

A key goal will be closer cooperation with the Arctic states, in creating data and services for permafrost areas to improve environmental and health security and develop mitigation measures.

Photo: www.european-union.europa.en

SCIENTIFIC COOPERATION IN THE ARCTIC

REDUCING BLACK CARBON EMISSIONS

The EU supports the Arctic Council's indicative target of reducing black carbon emissions that reach the Arctic by as much as 33% below 2013 levels by 2025. The EU encourages all Arctic states to ensure that their Arctic communities operate on renewables, reducing diesel (for electricity) use and reducing black carbon emissions. The EU will seek to reduce black carbon emissions through a multilateral approach with the US, Canada and others, building on the work in the Arctic Council, in line with the action announced in the recent Zero Pollution Action Plan.

EU-POLAR NET

EU-PolarNet coordinates the EU Polar Cluster, consisting of the European Polar Board, the Svalbard Integrated Arctic Earth Observing System and 21 EU-funded Polar projects. The projects investigate:

- drivers and changes in Arctic biodiversity;
- transitions in Arctic coastal systems; ice sheets and sea level rise projections;
- adaptation and sustainable development in the Arctic;
- capacity building in Arctic standardisation.

HEALTH IN THE ARCTIC POST COVID-19

The EU will aim to run specific projects with the World Health Organisation and the authorities of the most affected Arctic regions to strengthen and share knowledge and best practices on disease outbreaks, natural disasters, and other threats to wildlife, plants and humans from climate change and environmental degradation.

It will support the work of the "One Arctic, One Health" project, managed by the Arctic Council's Sustainable Development Working Group; the Arctic Council pays particular attention to the situation of Indigenous Peoples.

ARCTIC GEOPOLITICS

MAINTAINING A REGION OF PEACEFUL COOPERATION

Recent years has seen a rapid increase in the number of countries taking an interest in Arctic matters. This risks turning the Arctic into an arena of geopolitical competition and potentially harming the EU's interests. Besides a growing interest in Arctic resources and transport routes, there has also been an increase in military activities. The EU has a strong interest in maintaining good international cooperation. It will mainstream Arctic matters in its diplomatic relations and build on its engagement in regional bodies.

THE EU AND THE NORTHERN DIMENSION

The Northern Dimension (ND) is a common policy of the EU, Russia, Norway and Iceland. Belarus is one of the observers of the policy. Due to Russia's unprecedented military aggression against Ukraine and the involvement of Belarus in this aggression, the EU, Iceland and Norway suspended until further notice all activities of the Northern Dimension policy which involve Russia and Belarus, with a joint statement published on 8 March 2022.

The Northern Dimension policy was initiated in 1999, and renewed in 2006. The four ND Partnerships deal with: Environment (including nuclear safety); Public Health and Social Well-being; Transport and Logistics; and Culture. The Northern Dimension Institute serves the information needs of the policy.

Photo: www.european-union.europa.en

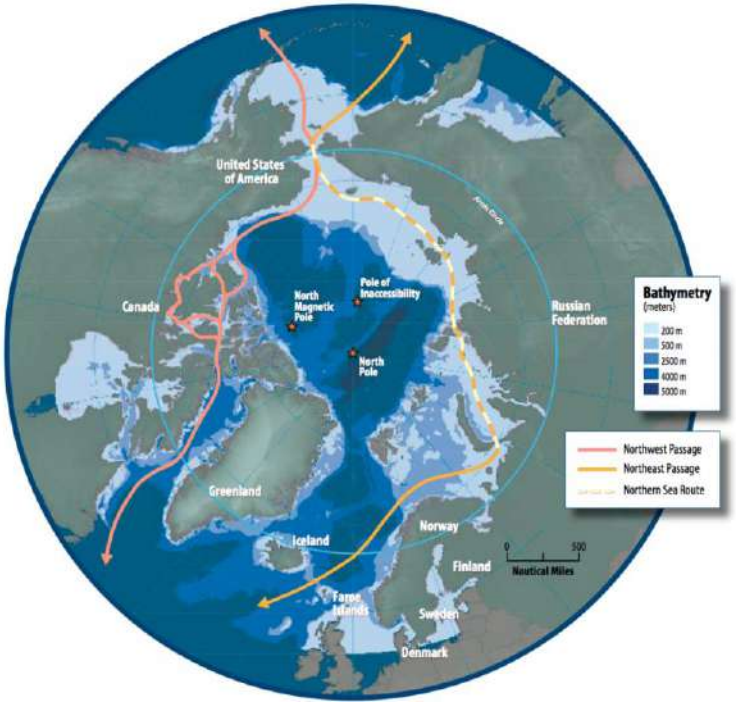


Photo: www.european-union.europa.en

The Northern Dimension Environmental Partnership (NDEP) improves wastewater treatment in the Baltic Sea catchment area and tackles black carbon emissions. Projects are implemented through the NDEP Support Fund (EUR 350 million in total) managed by the European Bank for Reconstruction and Development (EBRD).

The Nuclear Window of the NDEP is a multilateral funding mechanism aimed at addressing risks associated with the Soviet-era nuclear legacy in North-West Russia. The Barents Sea area has one of the largest accumulations of spent nuclear fuel and radioactive waste in the world. Contributors have provided EUR 166.3 million to the Nuclear Window since 2002. The EU has contributed EUR 44 million for the environmental window and EUR 40 million for the nuclear window.

NDEP projects have dramatically improved the environmental condition of the Baltic Sea and reduced the danger of radiological contamination of the Arctic Sea.

EU COOPERATION WITH GREENLAND

Under the Overseas Association Decision, Greenland has a wide-ranging political and policy dialogue with the EU, preferential trade arrangements to access the EU market and is one of the largest recipients of EU support per capita in the Overseas Countries and Territories (EUR 225 million foreseen between 2021 and 2027). This supports Greenland's sustainable development and diversification of its economy. So far, long-term EU cooperation has in particular contributed to strengthening the education system and enhancing learning opportunities, as knowledge and skills are essential for Greenland's socio-economic development.

The 2021 renewed EU-Greenland Sustainable Fisheries Partnership Agreement is an important milestone in the long-standing cooperation between the two, promoting sustainable use of marine resources. The EU is seeking to deepen and broaden its partnership with Greenland, including possible cooperation on issues related to green growth.

A permanent presence of the EU in Greenland would be a strong signal to enhance our partnership and the visibility of EU actions on the ground, for example through the establishment of a European Commission Office on Greenlandic territory.

EU SPECIAL ENVOY FOR ARCTIC MATTERS, CLARA GANSLANDT

In September 2022, Clara Ganslandt took up the role as Special Envoy for Arctic matters. Her role is to drive forward the EU's Arctic policy, enhance cooperation with partner countries and other interested parties, improve coordination between the different EU institutions, mainstream Arctic issues in policy-making, and promote and publicise the EU's Arctic engagement externally.

In October 2021, the High Representative and the European Commission published the EU's updated Arctic policy. Climate change is the biggest threat the Arctic is facing. It has reached an unprecedented crisis point. The European Green Deal is at the heart of the EU's Arctic engagement, together with our new approach for a sustainable blue economy, supported through science, innovation and regional investment. The EU will contribute to a peaceful and constructive dialogue, to help keep the Arctic safe and stable, by raising Arctic matters in its external contacts, intensifying regional cooperation and monitoring and anticipating emerging security challenges. It will take strong action to tackle the ecological, social, economic and political impact of climate change and environmental degradation. It will make the Arctic more resilient, through environmental legislation, concerted action against black carbon and permafrost thaw, and by pushing for oil, coal and gas to stay in the ground. And it will put people first, by supporting a comprehensive, inclusive and sustainable development of the Arctic regions to the benefit of its current inhabitants and future generations, with a particular emphasis on the needs of indigenous peoples, women and the young, and by investing in future-orientated jobs.

What happens in the Arctic is not just a matter for the 4-5 million people who live across the Arctic regions. It affects the entire planet. International cooperation is a must if we are to confront the challenges we face. The EU's approach will be based on its core values and principles.

Resource information:
www.european-union.europa.en

THE FAROE ISLANDS

THE FAROE ISLANDS AND THE ARCTIC

THE FAROE ISLANDS have a key position in the region, both in relation to the Northern sea route, and especially, situated as they are, the western arm of the Northeast Sea Route; which is expected to have the greatest significance in the years to come.

Shipping has already increased in the seas around the Faroe Islands, and this traffic is likely to expand even more in coming years. Increased maritime activity in such a large area, with many associated risks, requires high standards for safety and emergency response, both with respect to safeguarding human life and protecting the environment. This increasing activity also brings with it significant economic opportunities and the number of foreign ships using Faroese ports in the future will no doubt continue to grow. With long-term experience and initiative working in the Northern seas as a part of the Faroese maritime identity and culture, Faroe Islanders have the possibility to make the most of these valuable assets.

The Faroe Islands have vast experiences in fisheries in the seas of the High North and in order to ensure appropriate rights to participation in any new fisheries in the area, it is very important to closely follow negotiations regarding the future management of fisheries in the Arctic sea.

The economic and cultural basis of Faroese society is similar to that of other Arctic peoples. Faroese experts who participate in various areas of Arctic cooperation consider the commonalities shared with other Arctic countries as a great advantage in Arctic cooperation, compared with other international fora for research cooperation.

The Faroe Islands have long played an active role in regional cooperation in a range of different areas, both as a part of the Nordic family of nations, through cooperation in the West Nordic region and across the North Atlantic.

Strong and visible Faroese participation in Arctic cooperation, in particular within the framework of the Arctic Council, is a natural part of the continued development of the Faroe Islands as a reliable and constructive partner in international cooperation.

The Faroe Islands have the knowledge and experience necessary for the further development of fisheries, shipping and research, as well as the conservation and management of natural resources. In close cooperation with other countries and keeping a keen eye out for new opportunities, the goal is to create new opportunities for the Faroe Islands, both for individual citizens, as well as for the business sector and the research community.

THE ARCTIC COUNCIL

The Arctic Council is the only forum on high-level intergovernmental cooperation in Arctic matters. The member states are the United States, Russia, Canada, Sweden, Finland, Iceland, Norway and Denmark/Greenland/Faroe Islands.

The Arctic Council was established in 1996 and has its origins in the Arctic Environmental Protection Strategy (AEPS), which was established in 1991. AEPS is considered the first real step towards protecting the environment and promoting safety in the Arctic area in the aftermath of the Cold War.

The Faroe Islands have been active participants in the Arctic Council together with Greenland and Denmark since the late 1990's and also took part in the AEPS prior to the establishment of the Arctic Council.

The Faroe Islands are part of a delegation to the Arctic Council called Denmark/Greenland/Faroe Islands, which flies the flags of all three nations.

Photo: www.tinganes.fo

THE FAROE ISLANDS – A NATION IN THE ARCTIC

As an island nation in the West Nordic region of the Arctic, the Faroe Islands have very many political, economic and social challenges and opportunities in common with their neighbouring countries and communities across the High North.

Recognising this, the Government of the Faroe Islands commissioned a strategic assessment in 2012, which was to provide a deeper and broader understanding of the challenges and potential of the Faroe Islands in the years to come and their place in the future development of regional cooperation. The task was to examine in more detail how the Faroe Islands can best adapt to changing circumstances while creating and benefitting from new opportunities.

The assessment The Faroe Islands – a nation in the Arctic was presented in April 2013.

Faroese perspectives regarding the European Union's Arctic Policy.

Resource information:
www.government.fo/en/foreign-relations/the-arctic/
www.tinganes.fo

The EU is currently updating its Arctic Policy.

The Faroe Islands welcome the EU's initiative to update its Arctic Policy from 2016. This process provides an excellent opportunity to increase awareness about the Arctic region in the EU, to draw attention to the EU's engagement in the Arctic and to assess the effectiveness of the EU's Arctic policies so far.

Photo: www.tinganes.fo

FINLAND

INFORMATION AND ACTIONS FOR THE MITIGATION OF CLIMATE CHANGE

Climate change is one of the most significant environmental problems affecting the human population. It is linked to the global adequacy of natural resources, a decline in biodiversity as well as unsustainable means of consumption and production. The excessive utilisation of forests can result in a reduction of our carbon sink for decades into the future.

The Finnish Environment Institute promotes a solution-based sustainable bioeconomy by researching new policy measures and investigating the effect of various production and consumption solutions on emissions.

We produce innovations for the mitigation of climate change and to help people adapt to it. We support practical climate work in pioneering municipalities by carrying out emissions development assessments and disseminating information on good practices. Our objective is a low-carbon society that uses natural resources sustainably and is able to flexibly adapt to changes.

Around 40 researchers and specialists in various units carry out climate issues-related work. We take part in numerous national and international research projects and provide information on climate issues by producing content such as the climateguide.fi and the carbonneutralfinland.fi websites.

BUILDING A SUSTAINABLE ECONOMY

Society must move towards a sustainable economy in which less is used to produce more. Environmental problems are in great part due to the production and consumption of goods and services. Steps must be taken to significantly reduce the use of unrenewable natural resources and reduce the emissions and amount of waste we produce. Renewable natural resources must be used sustainably.

SYKE produces reliable information on sustainable consumption choices and production methods for consumers, companies and municipalities as well as to support environmental policy decision-making.

We promote the development and implementation of solutions based on a low-carbon circular bioeconomy. We assess the impacts of product and service lifecycles and develop tools for ecological product design. Our activities also emphasize the prevention of waste accumulation, recycling, wastewater and contaminated soil, the risks related to harmful substances as well as industry emissions.

We work together with research institutes, universities, companies organizations and citizens. We also engage in extensive work in international networks.

Photo: www.syke.fi/en-US/Research__Development/

AREAS OF EXPERTISE:

The sustainable use of natural resources

- Assessments on the sustainability of natural resources
- Sustainable use of ground water resources and stone materials
- Policy assessments and analyses on sustainable consumption and production
- Production of information on sustainable consumption choices and tools for supporting decision-making
- Environmentally-extended assessments of the national economy
- Nature-based solutions for societal problems

Sustainable water management

- Water management for municipalities and sparsely populated areas, circulation of nutrients in waste water as well as treatment of sludge from treatment plant

Tasks of authorities

- Government activities: international waste transfers, ozone and F-gases, POP and PIC contaminants and the EMAS
- Support for preparation of legislation: industry's environment permit procedures, wastes, chemicals, contaminated soil

Environmental management in industry

- Best available technology (BAT) information exchange

Hazardous substances

- Assessment and management of risks posed by hazardous substances from the perspective of the contaminated environment and circular economy
- Status assessments related to hazardous substances in waters
- Chemical analysis of hazardous substances and their ecotoxicological definition

Resource information:

www.syke.fi/en-US/Research__Development/

Climate and protection of ambient air

- Emissions inventories: air pollutants and greenhouse gases
- Modelling of energy use (particularly electricity) and air pollutants (especially nanoparticles and black carbon) as well as the research of methods to reduce their related harmful effects
- Supporting municipal measures for mitigating climate change and circular bioeconomy solutions

Leading marine research in Finland

The Baltic Sea is an important part of the Finnish national identity and international culture. As a shallow brackish water basin, the Baltic Sea is vulnerable and strained by the large population surrounding it. We produce information on the state and changes of the sea to support decision-making.

Research allows us to assess the impact of human activity on the Baltic Sea and its requirements for sustainable development. We produce methods for assessing the state of the sea and for maritime spatial planning, in addition to information to reconcile ecological, economic and societal goals.

Research and development projects

The goal of the environmental research conducted by Finland is to guarantee that our environment remains safe and favorable for people to live in, while preserving biodiversity and reducing the burdens we place on the environment.

Ongoing projects and project search

- Climate change mitigation and adaptation
- Sustainability of consumption and production
- Sustainability of land use and the built environment
- Sustainable management of the Baltic Sea and freshwater resources
- Maintaining ecosystem services and biodiversity

FRANCE

FRANCE

While its historical involvement in the polar regions may appear to favor the Antarctic over the Arctic, France still has a long history of involvement in the Circumpolar North dating back several centuries. French fishing and whaling fleets were active in the North Atlantic as early as the 17th century, and French explorers and *voyageurs* traveled through the northern parts of what is today Canada even before then. Foreshadowing the strong French scientific presence that would develop in the region, the *La Recherche* expedition was one of the most famous scientific expeditions of the 19th century—a legacy continued by later polar explorers such as Jean-Baptiste Charcot and Paul-Émile Victor. Today, the French sub-Arctic territory of Saint Pierre et Miquelon is another factor motivating Paris to engage with the region.

Within France, various organizations and governmental agencies have emerged as thought- and policy-leaders regarding the country's involvement in the Arctic. In 1992, the Institut Polaire Français Paul-Émile Victor (IPEV)—a public interest group composed of nine public and parastatal organizations—was founded. More recently, the French National Centre for Scientific Development (CNRS) created the French Arctic Initiative, which aims to coordinate the scientific activities performed by French universities and laboratories in the region. In 2006, the think-tank Le Cercle Polaire (CP) was founded with the aim of "developing and promoting a true scientific understanding of the Arctic and Antarctic regions, and [encouraging]...the preservation of polar environments." More recently, the Observatoire de l'Arctique was launched ahead of the publication of the 2016 Arctic Roadmap and is jointly led by the Fondation pour la Recherche Stratégique (FRS) and the Direction Générale des Relations Internationales et de la Stratégie (DGRIS), which is part of the Ministry of Armed Forces. The Observatory monitors trends that may affect France's strategic interests in the region.

In recognition of the growing importance of the polar regions, France appointed an Ambassador for international negotiations on the polar regions in 2009—at the time the first ambassador-level diplomat appointed specifically for the polar regions by a non-Arctic country. The post is currently held by Olivier Poivre d'Arvor.

In April 2022, France released its new Polar Strategy for 2030. It also announced new funding for existing French Arctic and Antarctic scientific research capabilities, as well as a new Arctic research base: the Tara Polar Station. The strategy notably includes security and geopolitical elements clarifying France's strategic approach to the Arctic. It also announced the creation of an Interministerial Committee for the Sea and the Poles, placed under the Prime Minister's authority.

France has been an observer on the Barents Euro-Arctic Council since 1990, acquired Observer status at the Arctic Council in 2000, and is a frequent participant in forums such as the Arctic Circle.

Photo: IPEV / Gladu R/V Marion Dufresne (IPEV)

SOLIDARITY AND INTERNATIONAL COOPERATION

In terms of polar research, France favours the value of solidarity.

Present through infrastructures in both poles, France will negotiate exchange agreements in kind with a number of countries, notably for the use of icebreakers, but also to minimize the construction of new stations. Partnerships in the Arctic with Canada and Denmark, for example, nonconsultative States Parties to the Antarctic Treaty, could allow them to benefit from privileged access to French sub-Antarctic and Antarctic infrastructures, thus avoiding additional artificialization of the white continent and carbon balances that are not in line with the requirements of scientific research.

More generally, the principle of service exchanges, thinking in terms of "North Pole-South Pole", is the best tool to enhance the value of French Antarctic and Sub-Antarctic infrastructures, and to indirectly increase a presence in the Arctic, all in the spirit of the agreements governing scientific operations at the poles: collaboration and not competition, leading to the minimization of the environmental impact of research activities.

If we had to prioritize countries with which cooperation would be beneficial beyond simple exchanges of services, Germany comes immediately to the top, even if France cannot follow it today in terms of financial commitment.

Cooperation with Russia, now suspended, was absolutely essential and the organization of the ASM4 during the Russian presidency of the Arctic Council provided an opportunity to strengthen it, including in areas of research that could have spin-offs in terms of the development of scientific knowledge, cooperation on nuclear decontamination, and significant environmental, ecological and economic advances.

The open question remains as to how France will be able to develop its future exchanges on the Antarctic and sub-Antarctic with the strategic and long-standing regional partner that Australia represents in the South Polar region.

STRENGTHENING ARCTIC RESEARCH AND ACADEMIC EXCHANGES

With more than 200 researchers working on the Arctic and sub-Arctic regions, France has a very strong expertise, both long-standing and internationally recognized. These researchers study the cryosphere (ice, snow, permafrost), the atmosphere (climate, meteorology), the oceans, ecology, geomorphology and geology of the Arctic basins and their margins, biogeochemistry, socio-cultural mutations, environmental risks and adaptations to climate change, human and social sciences, indigenous languages, geopolitics, environmental law. The transdisciplinary approach, which is the most effective in addressing Arctic issues, is widely favored.

French Arctic research relies on several European or bilateral infrastructures allowing missions, sampling and long-term observations as well as on numerous European and international cooperations with Arctic countries (Russia, Canada, Norway) and non-Arctic countries. Strengthened cooperation with Russia is a priority, especially on the analysis of the impact of global warming on permafrost and the effects of climate change on the Arctic: they could allow the support of one or two major projects, both in the Arctic and in the Antarctic, as was the case in the past. Finally, it is worth emphasizing the facilitation of access for French researchers to the Russian Arctic. With regard to Canada, exchanges can only develop within the framework of the Takuvik International Joint Unit (CNRS-University of Laval in Quebec), the France-Quebec Maritime Institute or the future agreement between the French Oceanographic Fleet and Amundsen Science for the access of researchers to the eponymous Canadian research icebreaker.

Resource information:
www.diplomatie.gouv.fr/en/
National Roadmap for the Arctic

GERMANY

GERMANY

CHANGING EARTH - SUSTAINING OUR FUTURE

The research program "Changing Earth - Sustaining our Future" combines the scientific expertise of 7 Helmholtz centers to systematically investigate the greatest challenges of our time, climate change, the extinction of species, environmental pollution and and the increasing vulnerability of a technological society to natural disasters - from the land surface to the oceans to the most remote polar regions.

Changing Earth - Sustaining our Future is the joint research program of the Research Field Earth and Environment. Funding is distributed competitively through the central Helmholtz procedure known as Program-oriented Funding (PoF). The fourth Program-oriented Funding period (PoF IV) has started with the beginning of 2021 and secures the participating Helmholtz centers the basic funding of their research activities in the program for the next seven years.

AWI is involved in six different topics within this program. In detail, these are:

Topic 1: The atmosphere at a time in global change
Topic 2: Ocean and cryosphere in climate (coordinated by AWI)
Topic 3: Coastal zones at a time of global change
Topic 4: Landscapes of the future – securring terrestrial ecosystems and freshwater resources under natural dynamics and global change
Topic 5: Marine and polar life: Sustaining biodiversity, biotic interactions and biogeochemical functions
Topic 6: Towards a sustainable bioeconomy

DIVISIONS

1. BIOSCIENCES

The biosciences division focuses on the identification and quantification of species and the investigation of their behaviour and living. We test scenarios of changing biodiversity and biogeochemical processes by coupled physical-biological models. Our main interest centres on interactions between biology and abiotic processes and in particular, on the carbon and energy cycle in the ecosystems of the polar regions and of the shelf and coastal regions of the North Sea.

Central research themes are (1) reactions of individuals, populations and communities on external influences, and (2) organisation and dynamics of populations, communities and ecosystems under natural and disturbed conditions. We are oriented towards the modern concept of biodiversity research. Our science is embedded in the interdisciplinary research program Changing Earth - Sustaining our Future.

The division biosciences is organized in nine sections (see below). Apart from numerous third-party funded projects, the Helmholtz Young Investigator Groups MarESys ARJEL and PlanktoSERV complement our innovative research profile.

2. GEOSCIENCES

We explore the evolution of the polar regions, past climatological and environmental states, as well as the recent reaction of the Earth system on natural and anthropogenic driven climate change. Scientists from Bremerhaven, Potsdam and Sylt are investigating which processes and interactions have been crucial for the development of the polar environment from past to present. In order to achieve this, they are taking an in-depth look at the sediment structures of the oceans, at terrestrial deposits and at the polar ice caps. Research is being conducted, e.g., on the composition and spreading of marine sediments, on the substance- and energy flow in permafrost regions, and on the structure and change in the earth's crust and polar ice caps. The necessary data and samples are acquired by employing research vessels, observatories, aircrafts, and satellite systems.

3. YOUNG INVESTIGATOR GROUPS

The junior research groups at the Alfred Wegener Institute are funded by the Federal Ministry of Education and Research, the Helmholtz Association and the European Research Council. There are currently 8 such groups at the institute.

Programs:

- ARJEL
- MarESys
- PALICE
- CLOC
- SiDe-EFFECT
- PermaRisk
- PlanktoSERV
- SSIP
- FluxWin
- SPACE

4. CLIMATE SCIENCES

Physical and chemical processes in the Earth's atmosphere, cryosphere and hydrosphere are the main determiners of climate. Our research focuses on a better understanding of theses processes and on assessing the natural climate variability as well as the anthropogenic impact inflicted. The development in the polar regions is what we are especially interested in. To improve our understanding of the components of the climate system and their interactions, we follow a twofold approach. On the one hand we operate observational and measurement systems for the Arctic and Antarctic, and on the other hand we push the development, optimization and verification of regional and global coupled climate models. We use research vessels, observatories, aircraft and satellite systems for our observations and are concerned with the development of the ocean, atmosphere, sea ice and ice shields. Process studies to assess small-scale phenomena on short time scales go hand in hand with long-term programmes documenting the development of the polar systems.

5. SPECIAL GROUPS

Germany carries out research activities in the following areas:

- Aquaculture
- North Sea Office
- Scientific Diving
- Scientific Computing
- Reklim
- Earth System Knowledge Platform
- Bionics

Photographer: Dr. Heidemarie Kassens/GEOMAR
German and Russian scientists in the Siberian Laptev Sea

Resource information:
www.awi.de

GREENLAND

GREENLAND

Greenland's policy is to promote the development of its society with a strong and sound international research program based on shared objectives.

Greenland's Parliament Act no. 5 of 29 November 2013 addresses research consultancy and the allocation of research funding. The Act emphasizes coordination and prioritization of research efforts and enhances Greenland's participation in international cooperative research initiatives.

ARCTIC RESEARCH FUNDERS

The Government of Greenland is the primary supporter of basic research in Greenland with funds distributed to various Greenlandic research institutions including the NIS – Greenland Research Council.

Danish public funding for Arctic research is provided through several Ministries, such as of Science, Energy, and Environment.

Foreign public funding is also provided through the European Union and the EU-Horizon 2020 Programme, UArctic, Research Council of Norway, US (via the National Science Foundation, National Oceanographic and Atmospheric Administration, Office of Naval Research, and NASA), Nordic Council of Ministers and Swiss National Science Foundation.

Private foundations, such as Aage V. Jensen Charity, Oak, Villum, and Carlsberg, also provide research funding.

Institutions include the University of Greenland, Greenland Institute of Natural Resources, Greenland Survey, Greenland National Museum & Archives, National Library and Groenlandica, H.M. Queen Ingrid's Hospital.

The Government of Greenland's Ministry of Science and Environment provides the coordinating function between the Minister and research Authorities and communities in and outside Greenland.

The Greenland Research Council (GRC) is an independent national administrative body for research consultancy, the granting of research funding and the dissemination of research.

Photographer: Mads Pihl / www.denmark.dk "Visit Greenland"

MAJOR ARCTIC RESEARCH AND EDUCATION

The International Arctic Hub has been established. The aim of the IAH is to facilitate National and International research on equal terms, and to involve the Greenlandic community in the scientific efforts.

CAPARDUS – Capacity-building in Arctic Standardization Development; under- standing and implementation of Arctic standards, safe activities, emergency prevention and response, improved understanding and conservation of the environment.

Greenland Climate Research Centre (GCRC) investigates effects of climate changes on local communities, the Greenland society and the marine ecosystem. It is a contact point for a large network of international researchers with interest in effects of climate in Greenland. GCRC works as a natural and social science hub for capacity building and knowledge building.

Greenland Ecosystem Monitoring (GEM) is an integrated monitoring and long-term research program on ecosystems and climate change effects and feedbacks in the Arctic.

Programme for Monitoring of the Greenland Ice Sheet (PROMICE) was initiated as an ongoing effort to assess changes in the mass budget of the Greenland ice sheet.

The Arctic Oil & Gas Research Centre examines the social and economic impacts of oil and gas activities in the Arctic with an emphasis on Greenland.

MARPART – Maritime Preparedness and International Partnership in the High North assesses the risk of the increased maritime activity in the Arctic and the challenges.

Greenland Science Week bridges science and society, business and government, for networking and cooperation in multi-disciplinary Arctic science. It also creates a networking and cooperation platform for Greenlandic and international science.

The Fulbright Arctic Initiative, Health and Infrastructure Working Group, brings together a network of scholars, professionals and applied researchers, and will address public-policy research questions relevant to Arctic nations' shared challenges and opportunities.

Arctic Monitoring and Assessment Programme (AMAP) monitors and assesses the status of the Arctic region with respect to pollution and climate change issues.

Graduates in higher education doubled over a decade and continues in combination with an increasing completion rate and number of students. New education programs established in 2019-2020 include Law, BEng in Fisheries Technology, economics and resource management, and international trade and marketing.

Resource information:
www.naalakkersuisut.gl/en

ICELAND

ICELAND

Icelandic Arctic Cooperation Network participates in various projects among those are:

Gender Equality in the Arctic (GEA) is an international collaborative project focusing on gender equality in the Arctic. We highlight the importance of recognition and appreciation of diversity in terms of discourses, gender, indigenous and non-indigenous peoples, governance, education, economies, social realities, sustainability and balanced participation in leadership and decision-making both in the public and private sectors.

The geopolitical and global economic significance of the Arctic region has been growing fast, inter alia because of climate change as well as resource and economic development. The changes we witness in the Arctic – ecological, social and economic – affect both men and women although sometimes in different ways.

The gap between women and men with regard to economic participation and political empowerment remains wide and must continue to be addressed. Our common goal is to secure equal opportunities for men and women, to enable boys and girls to lead the lives they desire in a world without discrimination. This subject must become an integral part of Arctic policies in order to strengthen social well-being and support sustainable development in the region.

The purpose of this project would be to promote an extensive, policy-relevant dialogue on issues of gender equality in the Arctic region in the context of current realities in terms of economic and social development as well as current and future challenges, inter alia relating to climatic and environmental changes.

1. The Arctic Council Sustainable Development Working Group endorses the Gender Equality in the Arctic project.

The purpose and expected outcome is to:

- Promote and expand the dialogue on Gender, Diversity and Equality in the Arctic.
- Provide a formal network of groups and experts, interested in issues of Gender, Diversity and Equality in the Arctic.
- Encourage cooperation with and between existing networks on Gender, Diversity and Equality in the Arctic.
- Provide an online platform for material and events relevant to Gender, Diversity and Equality in the Arctic.
- Organize, collaborate on and participate in workshops and conferences relevant to Gender, Diversity and Equality in the Arctic.

2. Arctic Climate Predictions: Pathways to Resilient, Sustainable Societies (ARCPATH)

ARCPATH is part of the Joint Nordic Initiative on Arctic Research. This was established in order to generate new insights into both the challenges and opportunities confronting the Arctic region. *The Responsible Development of the Arctic: Opportunities and Challenges – Pathways to Action* programme is cross-disciplinary, with three thematic priority areas:

- Drivers of Change - Interactions and Impacts
- Arctic Resource Development in a Global Context
- Waters, Ecologies and Life Environments

Other Nordic Centres of Excellence funded under this initiative include: Resource Extraction and Sustainable Arctic Communities (REXSAC); Reindeer Husbandry in a Globalizing North – Resilience, Adaptations and Pathways for Actions (ReiGN); Climate-change Effects on the Epidemiology of Infectious Diseases and the Impacts on Northern Societies (CLINF).

3. BizMentors

BizMentors will develop, scale and expand an innovative structured business mentoring initiative across a diverse range of settings with its partners in the NPA Region. BizMentors makes expertise accessible and inclusive at a low delivery cost in dispersed communities. As a free online service, entrepreneurs will be able to gain access to peer-to-peer business expertise that will equip them with the supports, skills, networks & confidence to take advantage of the unique natural capital and innovation capacity that remains untapped in the NPA region.

BizMentors, an interactive and inclusive mentoring platform aims to complement existing mentoring support offerings. This project will utilize a user-centric quadruple helix approach to overcome common challenges experienced by start-ups and SMEs in the NPA region. Through innovations and shared learning, this project will validate the existing model across partner regions and sectors. Having engaged with end users across the partner regions in the preparatory phase, piloting of the business-mentoring programme will focus on Agri-Food, the sector commonly associated with processing / refinement of natural resources in the partner countries. The mentoring model developed will be adapted to each region participating in the project, and ensure its transferability to other business sectors, and other countries (not just in the NPA region). To support this, a transnational Handbook of Best Practice will be developed that share lessons learned in the development of the online model and that can be used to address challenges in disparate regions. BizMentors will provide an inclusive free mentoring service that supports all startups and existing SMEs without exception. BizMentors will inform decision makers seeking to implement effective, low cost and sustainable mentoring solutions through mainstream programmes across the NPA and beyond.

4. People in arctic matters

In Iceland, numerous organizations and companies work in the interests of the Arctic. However, what do these organizations actually do and who works there? These are questions that many people think about when these issues are discussed, including in the media. That is why Norðurslóðanet is responsible for introducing individuals within these organizations and their activities. Among them are PAME, IASC, CAFF, Norðurslóðanet and Stofnun Vilhjálms Stefánsson, all of which are located in Borgur in the area of the University of Akureyri. The participation of the University of Akureyri and the town of Akureyri in Arctic issues and more is also discussed. These are interesting people in a variety of jobs, people who are educated in arctic studies, but also people who were unexpectedly bored into this path. All of these people have one thing in common: they are passionate about Arctic issues.

Photo: www.government.is

Resource information:
www.government.is
www.en.rannis.is

INDIA

INDIA

POLAR SCIENCE & CRYOSPHERE

1. Polar precipitation

Key objectives

- Observation of clouds and precipitation at the Maitri station on a long-term basis
- Study the variability in precipitation in different time scales
- Study the distribution of clouds and precipitation associated with mesoscale systems
- Simulation of precipitation using a regional atmospheric model
- Investigate the causes of variations in precipitation using the observations and the model.
- Investigate physical processes in the polar atmosphere and the interactions between atmosphere, sea ice and ocean.
- Improve understanding of the physical, chemical, and dynamical processes affecting the polar atmosphere including the Southern Ocean region.
- Study the variability of the polar climate and its teleconnections to the rest of the globe with special emphasis to the Indian region.

2. Sea ice-ocean climate interaction (Polar Remote Sensing)

Mission statement:

Monitoring and quantifying changes in Polar regions by employing satellite remote sensing, new techniques and in-situ data.

XII Five Year Plan Projects approved by MoES

- Satellite-based DEM for Monitoring Antarctic Surface Topography, with a Special Focus on Glaciers
- Hydrodynamics of the Indian Ocean Sector of Coastal Antarctica, with focus on Sea Ice

3. Microbial diversity

Biological studies conducted in the Polar regions spread over a wide range of aspects from evolutionary perspectives to harnessing biotechnological potential. Researchers are studying the composition and spatial distribution of bacteria, fungi, algae, mosses and lichens in various niches thereby addressing ecological aspects.

Objectives

- Diversity and distributional patterns of bacteria, cyanobacteria and fungi in the polar regions
- Determining the culturable and total microbial diversity in different microclimatic conditions in the region and their maintenance *in vitro*
- DNA Isolation & Sequencing
- Determining of microbial community through DGGE
- Comparing the microbial diversity at different sampling depths
- Comparison of bipolar species.

4. Cryosphere and climate

RESEARCH

We work towards understanding the modern biogeochemical and air to snow exchange processes and its past changes vis-à-vis the climate system and its variability. The proxy parameters used include temporal variability of stable water isotopes, trace metal chemistry, ionic composition, dust particulates, and microbial components that are reliable indicators of environmental change. We strive to carry out interdisciplinary research in Antarctic, Arctic and Himalayan regions.

5. Environmental monitoring

Antarctica and Southern Ocean are unique places to conduct study on ozone whole, atmospheric chemistry and dynamics, palaeoclimatic research from ice core and marine sediments (sun earth relationship, global climate change and genome research from cold regions). For environmental study, Antarctica provides a unique, unpolluted and stable environment for scientific observations. It is far away from all sources of environmental contamination and thus remains an unpolluted datum point from which global changes due to pollution could be monitored and therefore it is very important place to carry out significant study on environmental changes.

Environmental Protocol, which is also known as "Madrid Protocol" was adopted in 1991 in response to proposals that the wide range of provisions relating to protection of the Antarctic environment should be harmonized in a comprehensive and legally binding form. The Protocol on Environmental Protection to Antarctic Treaty and more commonly referred to as Environmental Protocol or Madrid Protocol came into force in 1998.

Environmental monitoring is a fundamental element of basic research, environmental management, and conservation. The organized and systematic measurement of selected variables provides for the establishment of baseline data and the identification of both natural and human-induced change in the environment" Monitoring data are important in the development of models of environmental processes, which in turn facilitate progress towards a predictive capability to detect environmental impact or change.

6. Kongsfjorden flagship program

Kongsfjorden, an icy archipelago having a length of about 40 km and width ranging from 5 to 10 km, is a glacial fjord in the Arctic (Svalbard). It lies in the northwest coast of Spitsbergen, the main island of Svalbard, and is a site where warmer waters of the Atlantic meet the colder waters of the Arctic. Being an open fjord without sill it is largely influenced by the processes on the adjacent shelf.

The Transformed Atlantic Water (TWA) from the west Spitsbergen current and the glacier-melt freshwater at the inner fjord creates strong temperature and salinity gradients along the length of the fjord. Southerly winds will produce down welling at the coast and cause hindrance on exchange processes between the shelf and the fjord, while the northerly winds will move the TWA water below the upper layer towards the coast. The melt water during summer not only stratifies the upper water column but also significantly alters the turbidity.

This would have profound influence on the seasonality in the phytoplankton biomass and primary production. Thus, an altered interaction between the Atlantic water with the (turbid) melt waters from tidal glaciers on a seasonal to inter-annual time-scale is likely to affect the pelagic ecosystem in the fjord. Alternately, the benthic ecosystem is more likely to be affected by long-term changes in the fjord hydrography and sedimentation.

Against the above backdrop of the climate sensitivity of the fjord system, NCPOR has initiated an ambitious multi-institutional program of long-term monitoring of the Kongsfjorden by deploying an Ocean-Atmosphere mooring system with regular repeat transects to measure physical and biogeochemical parameters on a seasonal scale. The overall objective is to establish a long-term comprehensive physical, chemical, biological and atmospheric measurement programme to study:

- The variability in the Arctic/Atlantic climate signal by understanding the interaction between the freshwater from the glacial run-off and Atlantic water from the west Spitsbergen current.
- The effect of interaction between the warm Atlantic water and the cold glacial-melt fresh water on the biological productivity and phytoplankton species composition and diversity within the fjord.
- The winter convection and its role in the biogeochemical cycling.
- The trigger mechanism of spring bloom and its temporal variability and biomass production, and
- The production and export of organic carbon in the fjord with a view to quantify the CO_2 flux.

Resource information:

www.moes.gov.in

ITALY

ITALY

The Arctic research program (PRA) presents itself as the instrument through which to support and implement the Italian strategy in the Arctic as regards the field of scientific research.

Based on this national strategy, the PRA has the task of identifying the objectives of Italian research in the Arctic over a 3-year period, identifying the actions through which to pursue and achieve these objectives, and implementing these actions.

The general objective of the PRA is to strengthen and integrate the national community that operates in the Arctic, also by offering funding opportunities and services (first of all a database). The PRA works for a growing integration of Italian polar research, whether it is aimed at the Arctic or Antarctica.

Photo: World Meteorological Organization

THE SCENERY

The research activity is fully integrated into the broader framework of the Italian effort in the Arctic and constitutes its essential pillar. As indicated in the document "Towards an Italian strategy for the Arctic - national guidelines", the strategic directions of Italian research in the Arctic include:

- Consolidation of the internationalization of research, extending the Italian presence in the pan-Arctic observation system, and promoting it in terms of scientific and technological "excellence".
- Active participation in the strengthening of research infrastructures in the Arctic, in particular and above all in their greater integration.
- The promotion of actions of innovation and technological experimentation.

On this basis, Italian research in the Arctic is strongly committed to supporting THE PRIORITIES that the international community pursues in research in the Arctic:

- promote the study and knowledge of the Arctic system with the necessary multidisciplinary and integrated approach;
- increase the spatial and temporal resolution of the Arctic observing system, strengthen its level of coordination, strengthen and better coordinate research infrastructures;
- contribute as much as possible to the coordination and development of a medium- and long-term scientific research agenda and priorities;
- contribute in a concrete way to the activities of the various fora and bodies, whether they are of a more scientific nature (IASC, EPB, SAON) or instead of a more properly political nature (Arctic Council and its working groups).

Resource information:
www.dta.cnr.it

JAPAN

JAPAN

In 2015, the Government of Japan adopted its first comprehensive and strategic Arctic policy, Japan's Arctic Policy. The policy clearly states that Japan will:

- make use of its strength in science and technology,
- give full consideration to the Arctic environment and ecosystem,
- ensure the rule of law and promote international cooperation.

It is important for Japan to play a leading role for sustainable development in the Arctic with foresight and policy based on science and technology. Japan focused on the Arctic policy as one of the main topics of the Third Basic Plan on Ocean Policy, approved by the Cabinet in May 2018, in order to accelerate addressing Arctic issues. In June 2019, the Councilors' Meeting of the Headquarters for Ocean Policy made recommendations on Arctic policy to specify priorities for the Government to advance the three thematic pillars of Japan's Arctic Policy; Research and Development, International Cooperation, and Sustainable Use. Based on these recommendations, the Arctic Challenge for Sustainability II (ArCS II) was launched in June 2020 as a new national Arctic-research project following on from ArCS (2015-2020).

The Arctic is the source region of cooling the planet's atmosphere and oceans. It is intimately linked to the Earth's climate and environment by way of the atmospheric circulation resulting from the temperature gradient between the Arctic and the heat source regions in the lower latitudes and the thermohaline circulation of Earth's oceans driven by deep-water formation. The Arctic is also the most sensitive area on the planet to man-made atmospheric changes such as global warming, ozone depression and acid rain.

The global climate and environment, so we pursue on-site observations of air quality, snow and ice, oceans, the terrestrial environment and the upper atmosphere in order to shed light on the actual situation and mechanisms of climactic and environmental change and their impact on ecosystems.

Photo: www. mext.go.jp/english

Advanced Scientific Research Project

- Approaching Earth System Dynamics Through the Past Polar Changes: Reconstruction of Quaternary Polar Environmental and Global Atmospheric Changes with High Accuracy and High Temporal Resolution

Resource information:

www.mext.go.jp/english
www.nipr.ac.jp/english
www.jamstec.go.jp/e/

Project Research

- KP-5 Variabilities and coupling processes in the middle and upper atmosphere in the polar regions
- KP-9 International collaborative studies on the arctic upper and middle atmosphere based on the EISCAT radar and ground-based observations
- KP-10 Preliminary Study of Warming in the Arctic
- KP-11 Study of arctic terrestrial ecosystem and environmental change

THE REPUBLIC OF KOREA

KOREA

The Korea Polar Research Institute has major strategies regarding its polar research in conducting various research and projects. The achievements from KOPRI are acknowledged both domestically and internationally.

DIVISION OF ATMOSPHERIC SCIENCES

The Division of Atmospheric Sciences observes and analyzes surface, upper and lower atmospheric phenomena in Polar regions, where global warming occurs rapidly, and conducts research for identifying the causes of climate change, predicting the future, and understanding how the polar climate system affects the climate change on the globe.

The Division of Atmospheric Sciences has been conducting research focusing on detailed research topics as below.

- Research on environmental changes in the permafrost of the Arctic
- Diagnosis of Antarctic Extreme Weather/Climate Change and Global Impact Assessment
- Development of Earth System Model-based Korea Polar Prediction System (KPOPS-Earth) and its Application to the High-impact Weather Events originated from the Changing Arctic Ocean and Sea Ice
- Occurrence of aurora and their correlations with polar upper atmospheric and climate variabilities

DIVISION OF EARTH SCIENCES

The Division of Earth Sciences explores and studies the geological environment of the polar continents and ocean. The current research is identifying the Earth's past and present, and predicting the future through research on the Antarctic continent, the Arctic ocean, meteorites and space materials, the Arctic Ocean's submarine resource environment, and also the fossil and paleoenvironment of Greenland.

The Division of Earth Sciences uses various methods such as geophysics, geochemistry, structures, geomagnetic, and paleontology to study the geological environment of the polar region such as the Antarctic and Arctic continents and oceans, and islands. The most important research in the Antarctic continent is located around the Transantarctic Mountains, where 70 percent of all of Antarctica's outcrops are distributed. Northern Victoria Land, where Jang Bogo Station is located, is characteristic to shows the evolution of the earth crust during Paleozoic to Cenozoic Era.

DIVISION OF GLACIAL ENVIRONMENT RESEARCH

The Division of Glacial Environment Research focuses on three studies: finding the causes of past environmental changes from polar marine deposits ice cores, identifying the causes of current cryosphere changes through various state-of-the-art polar observations, predicting future climate change through restoring observing past current climate change.

DIVISION OF OCEAN SCIENCES

The Division of Ocean Sciences focuses on the international joint investigation of ocean circulations and biogeochemical processes associated with the marine ecosystem characteristics in the Antarctic and Arctic Seas, undertaking expeditions in Polar regions led by the icebreaker ARAON.

The aim of our research are: (1) to address rapidly changing the Arctic-Antarctic marine environment under impacts of global warming and its causative mechanisms, and (2) their interactions with our global climate system.

DIVISION OF LIFE SCIENCES

The Division of Life Sciences study changes in polar ecosystems due to global warming and adaptation of organisms and conducts long-term ecological monitoring for the management and preservation of regions surrounding Arctic and Antarctic research stations, the Ross Sea Region Marine Protected Area· Antarctic Specially Protected Areas (ASPAs). In addition, we evaluate the value of polar biological resources and leads the commercialization by discovering valuable genetic resources and developing bio-advanced materials.

Photo: www.eng.kopri.re.kr

DEPARTMENT OF FUTURE TECHNOLOGY CONVERGENCE

One of the things polar scientists aspire to is advanced technologies. The development of advanced exploration technology is essential for further polar research. The Department of Future Technology Convergence consists of three separate units to accomplish these missions. The mission of the Office of Technology Development nbspand Service is to develop new technologies for field research. The Unit of Frontier Exploration develops a new traverse route (Korean route) to the Antarctic inland. Lastly, the role of the Office of Data Management is to manage data acquired from the researches in the polar region.

CENTER OF REMOTE SENSING AND GIS

The Center of Remote Sensing and GIS researches to observe and analyze various changes in the polar cryosphere, which is rapidly changing because of global warming. For this, remote sensing technologies are developed specializing in Polar regions using various research methods such as satellites, aircraft, drones, and on-site observation. The center studies the collection, efficient management and optimal analysis techniques of big data.

RESEARCH UNIT OF CRYOGENIC NOVEL MATERIAL

The Research Unit of Cryogenic Novel Material focuses on finding novel materials derived from the polar organisms and investigates its possibility as a useful application based on basic and applied research. Also, we study chemical and material changes that occur at cryogenic temperatures and conduct research on the development of new materials (environmental/energy) that can be used industrially.

Development of useful materials from polar origin and cryogenic based technology

Based on the keyword "Polar Cryogenic Science", the Research Unit of Cryogenic Novel Material is a research group that aims to study applications beyond basic/source studies of polar science.

The first major research is to counter the recently emerging antibiotic-resistant bacteria. The project aims to find new antibiotics through genetic and protein studies of polar organisms and demonstrates their utility. According to genomic analysis of microorganisms, various species secrete antibiotics in the Polar regions. Based on this fact, the research unit is researching to discover new antibiotics.

This study includes the development of new functional antibiotics with bactericidal effects on multi-drug resistant bacteria (MDRB) as well as the establishment of a library of antibiotic variants using antibiotic modification enzymes derived from polar microorganisms. This project from the research unit will provide essential knowledge in the drug development field and contribute significantly to infectious disease treatment.

The second major research is the investigation of ice microstructure properties for developing low-temperature purification and environment/energy materials.

Ice is an abundant material in the Polar regions, makes up 80% of the fresh water on Earth and covers 10% to 20% of the Earth's surface. The Research Unit of Cryogenic Novel Material is studying the physical, chemical, and biological characteristics and properties of the ice. Also, the research unit is finding the relation between the ice in polar regions and climate change and developing ice-based novel applications.

Resource information:
www.eng.kopri.re.kr

THE NETHERLANDS

THE NETHERLANDS

The Netherlands is a seafaring nation with a proud history of exploration, and a Dutch the explorer Willem Barentsz originally discovered Svalbard in 1596. Dutch exploration in the Arctic region continued, and Dutch nationals have been engaged in industry and commerce in the area since the 16th century, when they were active in whaling and cod fishing. Present-day involvement includes polar research and the activities of Dutch NGOs and companies including, until recently, Shell.

The Netherlands has several strong areas of interest in the Arctic, both in research and industry. The main concerns of the Netherlands are the impact of climate change, due to its low-lying coastlines, and Arctic cooperation and security. Before Shell moved its headquarters to the UK, Dutch concerns in the Arctic were also related to the future of the oil and gas industry. The Arctic Center for Polar Research in Groningen is an example of the importance that the Dutch place on the region. In 2022, the second Netherlands Scientific Expedition Edgeøya Spitsbergen (SEES) took place. The Netherlands has also been contributing to working groups of the Arctic Council, through for example Wageningen University's Arctic Marine Litter Project. Furthermore, in 2016 the Dutch appointed their first Arctic Ambassador, Ambassador Kees Rade. Ambassador Carola van Rijnsoever replaced Ambassador Rade in 2017. As of October 2022, the Arctic Ambassador of the Netherlands is René van Hell. The Dutch also have an Arctic station in Ny-Alesund, Svalbard that is run by the Arctic Centre in Groningen.

PROJECTS

CIRCUMPOLAR BIODIVERSITY MONITORING PROGRAM (CBMP)

An international network of scientists, governments, Indigenous organizations and conservation groups working to harmonize and integrate efforts to monitor the Arctic's living resources.

CIRCUMPOLAR SEABIRD EXPERT GROUP (CBIRD)

Since seabirds travel great distances over both marine and terrestrial environments, they are excellent indicators of overall ecosystem health.

ACTIONS FOR ARCTIC BIODIVERSITY

Implementing the recommendations of the Arctic Biodiversity Assessment.

ARCTIC SUSTAINABLE ENERGY FUTURES TOOLKIT

The project created a comprehensive long-term energy planning process for socially desirable and economically feasible energy solutions for communities in the Arctic by developing an Arctic Sustainable Energy Futures Framework (ASEFF) and an ASEFF Toolkit.

ARCTIC MIGRATORY BIRDS INITIATIVE (AMBI)

Improving the status and secure the long-term sustainability of declining Arctic breeding migratory bird populations.

RADIOACTIVITY IN THE ARCTIC

While the pollution levels posed by radioactivity in the Arctic are low and appear to be decreasing, the need to keep monitoring radioactivity in the Arctic remains unchanged.

Photographer: Udo Prinsen
The Netherlands Arctic Station

Photographer: Udo Prinsen
The Netherlands Arctic Station

Resource information:
www.nwo.nl

NORWAY

NORWAY

The Norwegian Polar Institute runs management-oriented scientific research, mapping and monitoring in the Arctic and Antarctica. Climate, environmental pollutants, biodiversity and geological mapping are important fields of work for the institute.

RESEARCH

Ocean and Sea Ice

We conduct research and monitoring in physical and chemical oceanography and sea ice physics, which contributes to the institute's ability to advise on the current status and changes of ocean and sea ice properties and processes in the Polar regions, quantifying and mapping these properties and their changes, and improving our understanding of processes in the polar oceans to improve climate and process models and future predictions.

Special emphasis is placed on long-term monitoring of ocean and sea ice status and changes in the regions Fram Strait, around Svalbard, the Arctic Ocean north of Svalbard, and the Southern Ocean north of Dronning Maud Land.

Projects

- Fram Strait
- A-TWAIN
- CRiceS
- Fimbul ice shelf
- Nansen Legacy

BIODIVERSITY

We conduct monitoring and research activities in marine and terrestrial environments in both Polar Regions. Key ecosystem components and linkages among them and the physical environments that comprise their habitats, are particular focal points for programmes in Biodiversity.

Knowledge required for management of hunted species and species under threat ("Red Listed") dictate central monitoring and research themes in the research group; climate change impacts are a unifying theme across many programmes. Demographic and ecological studies dominate NPI's Biodiversity programme project portfolio.

Monitoring

- Polar bear monitoring
- COAT
- SEAPOP
- CEMP

Projects

- Seabird tracking (2014-2018)
- ICE-WHALES (2015-2019)
- Arctic fox spatial ecology (2012-2019)

Environmental Pollution

We conduct research on how environmental pollutants and plastics are included in Arctic food chains, their sources, accumulation and long-term trends. We study health effects in species high up in the food chain, and map how climate change affects pollutants in the European Arctic.

Our focus is also on marine ecology for ice-dependent species of flora and fauna around Svalbard, on the Barents Sea, the North Sea and the Southern Ocean. In particular, research is conducted on how climate change affects ice and the ecosystem in the marginal ice zone and in the fjords.

Projects

1. TaxMArc
2. ID ARCTIC
3. OASYS
4. ARKTISMOD
5. Giants of the ocean – affected by anthropogenic pollutants?
6. Nansen Legacy
7. HAVOC
8. TIGRIF

Photo: www.lifeinnorway.net

Geology and Geophysics

We work with various aspects of glaciology, atmospheric science, marine geology, and bedrock geology, in both the Arctic and Antarctica. Much research is directly based on field observations, giving us crucial information on the changes and effect of climate in polar system.

Tasks involved monitoring, mapping and process studies.

Monitoring

- Kongsfjorden marine sediments
- Snow and soot
- Atmospheric radiation (Troll og Zeppelin)
- Mass balance glaciers

Projects

- OCTEL
- MADICE (2016–2020)
- Beyond Epica-Oldest Ice (BE-OI)
- Kongsvegen geophysical observatory
- TIGRIF
- Nansen Legacy
- HOLIS
- NARE geology

Resource information:

www.rcn.no
www.npolar.no

POLAND

POLAND

The principal research in polar areas are the following:

1. Scientific curiosity – a desire to understand phenomena in the planet's polar regions to determine the laws and regularities governing the Earth's environmental system, both in the case of physical and biological systems;

2. A desire to learn about the processes currently shaping polar regions, with the aim of understanding the geological past of our country, which was once covered by an ice sheet; among other things, this involves identifying mineral deposits and groundwater;

3. A desire to learn about climate changes and their effects both in the Earth's sensitive polar regions as well as globally with the aim of better understanding effects of these processes on Poland and Europe;

4. A desire to acquire practical knowledge of the technical and material aspects of human activity in the polar regions, and how the human body functions in extreme environmental conditions;

5. A need to better understand the social-political dimension of the polar regions, which is key to conducting responsible and effective international policy in the conservation and sustainable development of these areas.

The goal of the Polish polar research strategy is to identify areas of future development for Polish research in the Arctic and the Antarctic from a cognitive and economic perspective, as well as in terms of their social utility, and with the aim of bolstering Poland's international standing.

Four main areas of future research are proposed, considering their complementary and thus interdisciplinary character.

1) The acquisition of more in-depth knowledge of the abiotic components of the polar environment, as well as the regularities and laws governing their functioning.

2) Advanced diagnosis of the state of, and biotic changes occurring to different components of the environment in the Polar regions, including the laws governing them.

3) Achieving a better understanding of the determinants, course, and consequences of processes related to human activity in polar conditions, and the social dimension of Polar regions as a feature of Polish social sciences and humanities in the future.

4) Embarking on broader applied research focused on the use of advanced technical solutions in extreme polar conditions (also as analogues for space conditions), testing materials, equipment and technical systems, and using Polish polar platforms for space research and astronomical observations.

These proposed areas of research vary in relation to the range of achievements, personnel, and infrastructure involved. In some of these areas, Poland boasts research teams that are strong and well respected international partners. Some offer long- term and systematic series of observations, while others stimulate innovative ideas and research proposals, which could inspire significant interest.

Notwithstanding the above, any further significant development in Polish polar research in the future will depend on the performance of the following major tasks:

- Enforcing Poland's active and already considerable research presence in the polar regions
- Involvement in scientific research in polar regions
- Building Poland' image on the international scientific stage
- Providing expert advice in support of industry and policy
- Building polar research synergies and developing innovation
- Teaching and training new generations of polar researchers
- Actively participating in efforts aimed at protecting polar regions
- Engaging community involvement (education and outreach activities)
- Improving logistics in the polar regions

International research areas in which Polish academics maintain an important and independent position

- Long-term measurement series monitoring key parameters in the polar environment.
- Systematics and taxonomy of polar organisms.

In light of taxonomic impediment problem in world science, there is increasing pressure to identify the Earth' biodiversity. One great asset of several Polish scientific institutions is that they have maintained expert capable of identifying and describing staff species. Therefore, Polish researchers play an important role in international collaboration in this area.

Research on the evolution of polar landscapes – interdisciplinary research based on many years of field studies in landscap ecology, soil science, and botany in the Svalbard region.

Research in the field of paleobiology – in particular, tracing the evolution of Antarctic fauna making major discoveries in the Antarctic Peninsula and islands around the Antarctic.

Research on the Arctic climate and changes in that climate in history – in particular, reconstructions of the Arctic climate (Polish results were used to improve data supplied by the 20th Century Reanalysis Project)

Monitoring of bioindicators (mammals and birds) on King George Island – identifying and observing key changes in ecological elements of the Antarctic ecosystem and describing the interaction between life cycles of animals, their access to food, and density of predators. Monitoring is conducted on the west coast of Admiralty Bay. Some of the data obtained in this way is used in the international monitoring of bioindicators within the framework of the CCAMLR Ecosystem Monitoring Program, the aim of which is to ensure the safe commercial exploitation of species in the Southern Ocean (krill, fish).

The evolution of the paleoclimate and paleoenvironment of the Western Antarctic because of the formation of the Antarctic ice cover and the different stages in its development based on the geological record – research in this area is vital to explaining the causes of modern climactic change.

Geomorphological research – on the typology and transformations of the glacial and post-glacial landforms.

Resource information:

www.kbp.pan.pl
www.pkpolar.pl
www.polarknow.us.edu.pl/csp-2/

PEOPLE'S REPUBLIC OF CHINA

PEOPLE'S REPUBLIC OF CHINA

DEEPENING THE EXPLORATION AND UNDERSTANDING OF THE ARCTIC

The Arctic holds great value for scientific research. To explore and understand the Arctic serves as the priority and focus for China in its Arctic activities.

China actively promotes scientific expedition and research in the Arctic. China respects the Arctic States' exclusive jurisdiction over research activities under their national jurisdiction, maintains that scientific research in areas under the jurisdiction of Arctic States should be carried out through cooperation in accordance with the law, and stresses that all States have the freedom of scientific research on the high seas of the Arctic Ocean. China is actively involved in multidisciplinary research including Arctic geology, geography, ice and snow, hydrology, meteorology, sea ice, biology, ecology, geophysics and marine chemistry. It actively participates in monitoring and assessing local climatic and environmental changes, and carries out multi-level and multi-domain continuous observation of atmosphere, sea, sea ice, glaciers, soil, bio-ecological character and environmental quality through the establishment of multi-element Arctic observation system, construction of cooperative research (observation) stations, and development of and participation in the Arctic observation network. China is committed to improving its capacity in Arctic expedition and research, strengthening the construction, maintenance and functions of research stations, vessels and other supporting platforms in the Arctic, and promoting the building of icebreakers for scientific purposes.

China encourages the development of environment-friendly polar technical equipment, actively participates in the building of infrastructure for Arctic development, pushes for the upgrade of equipment in the fields of deep sea exploration, ice zone prospecting, and atmosphere and biology observation, and promotes technology innovation in Arctic oil and gas drilling and exploitation, renewable energy development, navigation and monitoring in ice zones, and construction of new-type icebreakers.

China supports and encourages research activities in the Arctic by constantly increasing investment in scientific research, building modernized research platforms, and improving the capacity in, and level of, research on the Arctic. It is making a greater effort to advance research in the fields of natural science, climate change and ecological environment, accelerate the development of basic subjects such as physics, chemistry, life science and earth science, strengthen social science research including Arctic politics, economy, law, society, history, culture and management of Arctic activities, and promote innovation in both natural and social sciences. It is also working to strengthen personnel training and public awareness of the Arctic, support higher learning and research institutions to train professionals specialized in natural and social sciences on the Arctic, build science popularization and education centers, and publish cultural products on the Arctic to improve public knowledge. It actively promotes international cooperation on Arctic research, pushes for an open and inclusive international monitoring network of the Arctic environment, supports pragmatic cooperation through platforms such as the International Arctic Science Committee, encourages Chinese scientists to carry out international academic exchanges and cooperation on the Arctic, and encourages Chinese higher learning and research institutions to join the network of the University of the Arctic.

The Arctic has abundant resources, but a fragile ecosystem. China advocates protection and rational use of the region and encourages its enterprises to engage in international cooperation on the exploration for and utilization of Arctic resources by making the best use of their advantages in capital, technology and domestic market. China maintains that all activities to explore and utilize the Arctic should abide by treaties such as the UNCLOS and the Spitsbergen Treaty as well as general

protecting the eco-environment of the Arctic and respecting the interests and concerns of the indigenous peoples in the region.

AREAS OF COOPERATION

- China's participation in the development of Arctic shipping routes
- Participating in the exploration for and exploitation of oil, gas, mineral and other non-living resources
- Participating in conservation and utilization of fisheries and other living resources
- Participating in developing tourism resources

China takes an active part in the international governance of the Arctic. China upholds the current Arctic governance system with the UN Charter and the UNCLOS as its core, plays a constructive part in the making, interpretation, application and development of international rules regarding the Arctic, and safeguards the common interests of all nations and the international community.

China stands for steadily advancing international cooperation on the Arctic. It has worked to strengthen such cooperation under the Belt and Road Initiative according to the principle of extensive consultation, joint contribution and shared benefits and emphasized policy coordination, infrastructure connectivity, unimpeded trade, financial integration, and closer people-to-people ties. Concrete cooperation steps include coordinating development strategies with the Arctic States, encouraging joint efforts to build a blue economic passage linking China and Europe via the Arctic Ocean, enhancing Arctic digital connectivity, and building a global infrastructure network. China hopes to work for the common good of all parties and further common interests through the Arctic.

ENHANCING THE STUDY AND UNDERSTANDING OF THE ARCTIC

China plays a constructive role in the work of the International Maritime Organization, and makes solid efforts to fulfill its international responsibilities for ensuring maritime navigational security and preventing its ships from polluting the maritime environment. China advocates stronger international cooperation in maritime technology and a globally coordinated solution to reducing greenhouse gas emissions from maritime transport under the International Maritime Organization framework. China takes an active part in negotiations over high seas fisheries regulation in the Arctic, and calls for a legally binding international agreement for managing fishery resources in the high seas portion of the Arctic. The agreement should allow scientific research and exploratory fishing activities in the high seas portion of the Arctic, and protect the freedom of all States on the high seas in accordance with international law.

At the regional level, China takes an active part in Arctic intergovernmental mechanisms. China, as an accredited observer to the Arctic Council, highly values the Council's positive role in Arctic affairs, and recognizes it as the main intergovernmental forum on issues regarding the environment and sustainable development of the Arctic. China stands by the commitments it made when applying to become an observer to the Council. It fully supports the work of the Council, and dispatches experts to participate in the work of the Council including its Working Groups and Task Forces. China respects the Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic, the Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic, and the Agreement on Enhancing International Arctic Scientific Cooperation, all adopted by the Arctic Council. China also supports international cooperation through such platforms as the Arctic Science Ministerial Meeting.

Resource information:
www.en.most.gov.cn

PORTUGAL

PORTUGAL

The Portuguese Republic's commitment to Arctic science is in line with the EU Arctic Policy and acknowledges the global importance of Arctic processes with impacts for Portugal in the concerns of sea-level rise and coastal processes, climate, fisheries, and sea transportation among others. Mainland Portugal, the Azores and the Madeira archipelagos with their position in the North Atlantic are exposed to Arctic changes and the Portuguese Republic shares the international responsibility for contributing to improving the understanding of the Arctic and of its Global impacts.

Portugal aims at being an international reference as a non-Arctic nation with an Atlantic dimension investing in research, technology and innovation in the Arctic and ensuring that knowledge generated by scientific research underpins social and economic development.

ARCTIC RESEARCH FUNDERS

- Fundação para a Ciência e a Tecnologia, I. P. (Ministério da Ciência, Tecnologia e Ensino Superior).
- European Commission, mainly under H2020.
- Universities and Research Institutions.

MAJOR ARCTIC RESEARCH AND EDUCATION

Portugal has a long history of navigation, including the Polar and Sub-Polar regions. Following the 4th International Polar Year 2007-2008 Portugal started the implementation of a national program for Polar research - the Portuguese Polar Program (PROPOLAR) - created within the Portuguese Foundation for Science and Technology (FCT, I. P.). PROPOLAR opens annual calls for Polar research projects and has funded 26 projects in the Arctic and Sub-Arctic since 2013 focusing on themes such as atmospheric aerosols, terrestrial and marine biogeochemistry, permafrost and ecosystem dynamics, bird ecology, and marine zooplankton.

Portugal has been a member of the European Polar Board since 2006, the Forum of Arctic Research Operators since 2014 and the International Arctic Science Committee since 2015. For the first time, Portugal will host the Arctic Science Summit Week (ASSW) in March 2021, in Lisbon. FCT, I. P. is also committed to the IASC crosscutting program T-MOSAiC (Terrestrial Multidisciplinary distributed Observatories for the Study of Arctic Connections) with the international secretariat being hosted at the University of Lisbon and with two Portuguese on the Steering Committee (the Chair and a member). Portugal is represented in Polar scientific organizations such as the International Permafrost Association and the International Association for Cryospheric Sciences, and in international programs such as the Global Terrestrial Network for Permafrost (GTN-P/IPA/GCOS), with a Portuguese scientist on the Steering Committee. Portuguese research institutions participate in the EU Arctic cluster projects EU-POLARNET and NUNATARYUK. Portuguese research in the Arctic has been essentially conducted via partnerships with Canadian, Icelandic and Norwegian institutions. A MoU with Spain on Polar research was signed in 2009 and has been implemented mainly in the Antarctic, with a new cooperation strategy being fostered for the Arctic.

In 2017 FCT, I. P. initiated the process of developing a Research & Innovation Agenda in Polar Sciences and Technologies, a strategic document that is to be completed by the end of 2020 and that has mobilized experts from R&D institutions and companies in the identification of challenges and opportunities in the national scientific and technological system, especially in medium and long-term perspectives.

Photographer: Ragnar Axelsson

Portugal is leading the Atlantic Interactions Initiative, a new intergovernmental initiative to unleash the potential of the Atlantic for Society to be implemented through the Atlantic International Research Centre (AIR Centre). It fosters knowledge-driven solutions for Atlantic and Global Societal challenges that require interdisciplinary research and innovation of complex Earth systems through cooperation targeting the Atlantic.

Within this strategy, the Polar Regions play a key role, since they are deeply inter-related with Atlantic Ocean processes and dynamics and influence the whole circum-Atlantic region. Portugal's contribution to Arctic science will hence be mainly associated to the AIR Centre and fostered within its flagship initiatives, as follows:

The development of a collaborative scientific infrastructure designated Atlantic Pole to Pole Observation System of Systems (APPOSS) to set-up a holistic framework to provide the required measurements and to deliver the required services to cope with the identified user needs in Atlantic regions.

An All Atlantic Constellation of small satellites, which will use polar orbits, whereas, is planning to have key data/images downlinking location in the polar region.

The national framework for supporting Polar science implemented during the last 13 years has enabled a steady growth of the Portuguese scientific community in conducting Arctic research and promoted international cooperation with Arctic and non-Arctic nations.

Resource information:
www.eeas.europa.eu/eeas/eu-arctic

REPUBLIC OF SINGAPORE

REPUBLIC OF SINGAPORE

SINGAPORE has been vocal about its expansion of diplomatic efforts towards the Arctic since its submission for observer status to the Arctic Council in late 2011, but does not have a formal Arctic policy. In 2012, the Ministry of Foreign Affairs appointed a special envoy for Arctic affairs, who issued a number of statements on Singapore's interest in the region and attended regional events such as Arctic Frontiers and Arctic Circle. Currently, the Minister of State, Sam Tan, represents Singapore on Arctic affairs.

Through government statements, events, and actions Singapore has shown an interest in the relationship Arctic navigation of cargo ships will play for its port and maritime traffic. In 2013, Singapore gained observer status in the Arctic Council alongside China, Japan, South Korea, and India. Since its acceptance as an observer state, Singapore has matured into a well-respected Arctic actor, inviting Arctic Indigenous groups to the country, holding roundtable events, and playing an active role in shaping the Polar Code. Singapore is currently participating in three Arctic Council working groups: the Conservation of Arctic Flora and Fauna (CAFF); the Protection of the Marine Environment (PAME); and the Emergency Prevention, Preparedness and Response (EPPR).

Singapore contributes to the CAFF work through its Sungei Buloh Wetland Reserve, which provides a sanctuary to 34 species of Arctic migratory birds.

Further, Singapore has established itself as a capacity-building partner for Permanent Participants of the Arctic Council, all of which are Indigenous people's organizations. They have been invited to Singapore for courses on climate change adaptation through the Singapore Cooperation Programme, pursued cultural exchanges to discuss sustainable development and culture preservation, and have established a postgraduate scholarship program that allows Arctic Indigenous students to study public policy, public administration, and maritime studies in Singapore.

Whereas most Non-arctic States have an interest in importing natural resources extracted from the Arctic, Singapore is more interested in exporting its own expertise and technologies to the region. Singapore is one of the world's leading maritime nations, with the second largest international port. As a regional shipping hub, Singapore sees the transit of most maritime cargo from Eastern to Western markets. Between 70 to 80 percent of all oil bound for China and Japan passes through the Strait of Malacca. With so much nautical activity, Singapore has significant expertise in port management, maritime trade, and shipping technology. This expertise goes beyond the technical to also include Singapore's experience in global governance regimes and institutions for ocean management and transportation, such as the International Maritime Organization (IMO).

Both the government and private companies have expressed interest in sharing this expertise with Arctic operators, port cities, and stakes. This expertise export also includes support technologies for natural resource exploration and extraction, such as offshore support vessels, oil and gas drilling units, and jack-up rigs.

Singapore's government and companies are interested in contributing tools, infrastructure, as well as offshore and marine engineering knowledge to support development activities, as well as providing management expertise in port operations and maritime traffic.

Photographer: Joe Raedle/Getty Images
Boats sail among the icebergs of the Jakobshavn Glacier in Greenland inside the Arctic Circle

Resource information:
www.thearcticinstitute.org

RUSSIA

RUSSIA AND THE ARCTIC IN 2021

In 2021, Russia successfully continued construction of the ice-resistant North Pole platform and conducted two comprehensive international expeditions that collected new data from the polar regions of the planet.

Russian scientists studied permafrost in the Arctic, the volume of glaciers and the frequency of auroras, the dynamics of sea ice and the structure of atmospheric circulation, oceanographic processes. These data are especially important not only for the development of fundamental science, but will also be used to provide safe navigation along the Northern Sea Route (NSR), creating of monitoring system of permafrost, assessment of climate changes, improving of models and forecasting methods.

As part of the activities of the High-latitude Arctic Expedition of the Arctic and Antarctic Research Institute (AARI), an annual cycle of observations and research in meteorology, aerology, geophysics, oceanography and ice science was conducted at the research station (ISS) "Ice Base Cape Baranov". A number of new modern measuring instruments were put into operation and a database of mass-balance and parametric characteristics of high-latitude Arctic glaciers was created.

Within the framework of international cooperation of FGBU AARI with the Finnish Meteorological Institute (Finland), the Korean Polar Research Institute (South Korea), the University of Trier (Germany) and the National Institute for Polar Research (Japan) at the research station "Ice Base "Cape Baranov" joint studies of atmospheric processes and observations in the area of atmospheric pollution in the station area were carried out.

Regularities of energy-mass exchange processes of the atmosphere and underlying surface were determined based on direct observations and their assimilation during modelling. Measurements were made according to the BSRN (Base Radiation Observation Network) program.

During the expedition "North-2021" the scientific staff continued hydrological studies of land waters, glaciological studies on the glaciers of Semenov-Tyan-Shansky, Mushketov and Voitsekhovsky, geological and geomorphological studies on Bolshevik Island.

Specialists of the Russian Arctic Expedition on Spitsbergen Archipelago (RAE-SH) of FGBU AARI deployed a comprehensive system of observations for research in meteorology, oceanology, hydrology, glaciology, geophysics and ecology near the village of Barentsburg.

Photo: www.aari.ru

Experimental work is being carried out to assess the intensity of evaporation from the surface of the snow cover and snowmelt processes to clarify the water balance of the watershed and to study the thermal structure and volumes of the Spitsbergen glaciers. Thermometric wells drilled in the 1970s-80s were restored in Pyramid settlement and included in the monitoring system for permafrost soils.

In coordination with the University Center in Spitzbergen (UNIS), oceanographic measuring equipment for long-term observations was installed in the Gulf of Isfjord. Research on the archipelago will make it possible to trace the evolution of permafrost, assess the transformation of glaciers and the mechanism of Atlantic water flow into the fjords of the archipelago, and provide the basis for simulating the interaction of the atmosphere with the underlying surface in the rapidly changing environment of Spitsbergen.

The AARI takes an active part in preparing documents for creating a state system for monitoring the state of permafrost on the basis of the Roshydromet observation network. Methodological recommendations have been formulated for organizing geocryological monitoring on the Roshydromet observation network and the model data have been compared with the results of geocryological measurements based on the RSCh and the ice base ice research vessel "Mys Baranov".

Comprehensive monitoring of surface water bodies and their catchments was carried out. In particular, an action plan was agreed to develop a domestic platform for data collection and transmission at the field base of the Federal State Budgetary Institution "The Arctic and Antarctic Research Institute". "Ladoga". At the field base the polygon for testing the platform was organized, sensors, gauges and software tools were tested.

In 2021, the AARI staff took part in national and international Arctic expeditions.

Within the framework of the international Russian-German-Swiss expedition "Arctic - 2021" in cooperation with the Swiss Polar Fund there had been gathered a lot of information about the state of environment in the water areas and islands of the Barents and Kara Seas, and also of the Laptev Sea under the conditions of changing climate.

The NABOS-2021 marine scientific expedition was conducted in cooperation with the International Arctic Research Center, University of Alaska.

As part of the expedition "Arctic Floating University" specialists of FGBU AARI conducted oceanographic, meteorological and atmospheric pollution observations. In the course of two trips of the atomic icebreaker "50 Years of Victory" to the North Pole with the help of a specialized shipboard telemetry complex there was obtained a statistically significant amount of measurements of the thickness of smooth ice and snow depth in the drifting ice.

One of the most important projects of Roshydromet FGBU AARI is the construction of the ice-resistant self-moving platform "North Pole" for researches in the high-latitude Arctic. By the end of 2021 its readiness was more than 90%.

Photo: www.aari.ru

In 2021 FGBU AARI participated in the projects of the Russian Foundation for Basic Research (RFBR) and the Russian Science Foundation (RSF) on the following topics: Arctic climate, permafrost in the high latitude Arctic, subglacial Lake Vostok, magnetospheric disturbances, paleogeography of the Antarctic marginal zone, microbial biogeochemistry of Central Antarctica. A permafrost-monitoring site was created on Kheysa Island and new data were obtained on the state of permafrost soils on the archipelagos of Novaya Zemlya and Franz Josef Land.

The AARI pays special attention to the development of the monitoring system and hydrometeorological support for year-round transit navigation along the Northern Sea Route. To improve the operation of the "North" system algorithms have been developed for obtaining characteristics of ice cover condition and dynamics, short-term numerical forecast of hydrological regime elements and iceberg drift. A number of companies that ordered special hydrometeorological support using the "North" system successfully conducted voyages in the navigation season of 2021.

As part of the research into the processes of interaction between ice and engineering structures, the basic provisions of the method of numerical simulation of ice cracking against the hull of a moving vessel have been developed, a list of dangerous scenarios of navigation in ice conditions for different types of vessels has been generated. The method of ice compression modeling in the ice test basin of the FGBU AARI has been developed for the experimental assessment of ice impact on engineering structures.

The work on research of the Arctic climate continued. Employees of FGBU AARII have prepared a review of climate changes for 1991-2020 and developed plans for adaptation to climate changes in the Arctic zone of the Russian Federation. It was noted that under the influence of global warming the frequency and intensity of extreme natural phenomena has increased.

During the year the paleodata base on climate changes in the Arctic and Antarctic and the database of modern climatic monitoring were replenished. There were obtained estimates of the influence of low latitudes on climate and sea ice changes in the Arctic for the last 40 years and new data of diatom and sporo-pollen analyses of deposits of West Spitsbergen. Maps of spatial and temporal distribution of auroral absorption at different values of the index of geo-magnetic activity of the Polar Cap and estimated the position of the equatorial boundary of the auroral oval (auroral oval) at different levels of magnetic perturbation. These works are important in terms of improving the accuracy of diagnostics of the high-latitude ionosphere state, conditions of radio-wave propagation and informativeness of electronic resources of space weather monitoring and forecasting services.

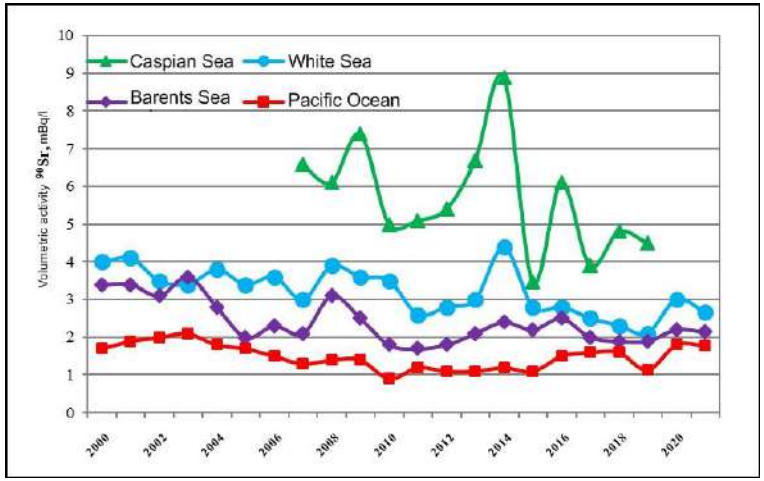


Figure. Dynamics of 90Sr volumetric activity in the coastal waters of the White and Barents Seas compared to the waters of the Caspian Sea and the Pacific Ocean near the eastern coast of Kamchatka in 2000-2021, mBq/L

AMAP's long-term radioactivity program has established a radioactivity expert panel that collects and evaluates data and information from monitoring and other relevant research in the Arctic. AMAP maintains a list of its expert panel members, who are appointed through an open process and contribute to the work as independent experts. All AMAP assessment reports undergo an independent peer review process.

The Russian Federation monitors the radiation situation in the White and Barents Seas. Volumetric activity of90Sr strontium in the coastal waters of the White and Barents Seas is mainly analyzed.

Here is data from the latest "Review of environmental conditions and pollution in the Russian Federation for 2021", material prepared by Typhoon.

During the period from 2000 to 2016 the volumetric activity of 90Sr in the coastal waters of the White Sea and the Barents Sea fluctuated between 1.7 and 4.4 mBq/L. Since 2017, 90Sr activity in the White Sea has been steadily decreasing and in 2019 was 2.1 mBq/L, while in the Barents Sea there was a stabilization at about 1.9 mBq/L. These levels occupied the middle position by the value of 90Sr activity, between the lowest values in the Pacific Ocean, near the eastern coast of Kamchatka, and the waters of the Caspian Sea (figure). The concentration in the White Sea was almost always higher than in the Barents Sea. In the Pacific Ocean, there is a decrease in 90Sr activity to 1.14 mBq/L in 2019. In 2020 in the Pacific Ocean and in the White and Barents Seas 90Sr activity increased - to 1.8 mBq/L, 3.0 mBq/L, and 2.2 mBq/L respectively, in 2021 there was a slight decrease of 90Sr activity in the White Sea to 2.7 mBq/L.

As the joint Russian-Norwegian-Russian studies since 1992 showed, the radionuclide content in the Barents Sea is considerably affected by transboundary transfer of radionuclides, removed to the Irish Sea and the English Channel from the plants reprocessing spent nuclear fuel from England and France.

Komsomolets nuclear submarines sunk due to accidents in the Norwegian Sea, whose waters are exchanged with the waters of the Barents Sea, and the K-159 in the Barents Sea near Kildin Island are potential sources of technogenic radionuclides to the waters of the Barents Sea. Kil'din. In the areas where they are located, periodic comprehensive surveys of the marine environment are conducted: water, bottom sediments and marine organisms. The investigations show that there are no leakages of radioactive materials from sunken submarines.

Thus, the radioactive contamination of the Arctic air and water environment in 2021 was at a low level and corresponded to the general dynamics of its steady decrease in the period 2016-2020.

RUSSIA AND THE ARCTIC IN 2022-2023

INTERNATIONAL ARCTIC STATION "SNEZHINKA" is a year-round and fully autonomous complex based on renewable energy sources and hydrogen power, without diesel fuel.

The project is designed and planned to be launched during the Russian Federation presidency in the Arctic Council in 2021-2023 of the International Arctic Station Snezhinka as a scientific and educational platform-form for international cooperation of engineers, researchers, scientists and scientific youth.

OBJECTIVE - to test and demonstrate to Russian and international partners in the following areas:

- environmentally friendly life support technologies and smart home/settlement systems;
- robotics;
- telecommunications;
- medicine;
- biotechnology;
- new materials;
- solutions using artificial intelligence.

Photo: www.arctic-mipt.com

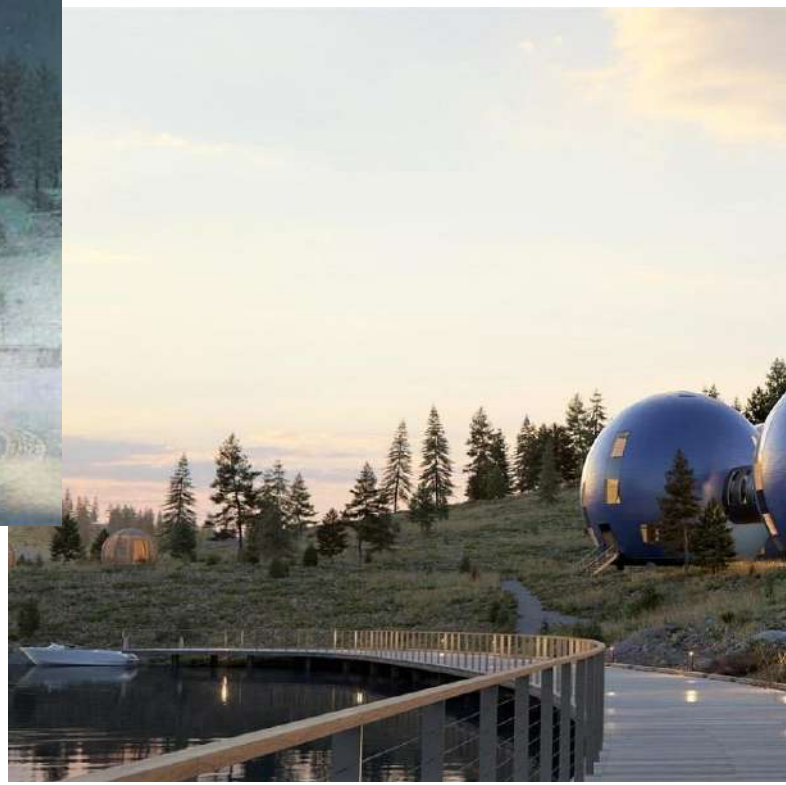


Photo: www.arctic-mipt.com

The project also supports collaborative research on ecology, climate change, pollution, and the world's oceans.

The station site in the format of a "living laboratory" will become a technological and economic base for replicating new solutions in our lives. Bold solutions become the basis for life and work in the Arctic today!

The area of the complex is about 4500 sq.m. for accommodating at least 80 people - long-term accommodation and work of the crews and their rotation.

MODULARITY of the complex allows the gradual development of the station.

Photo: www.arctic-mipt.com

BASIC MODULES

- Laboratory modules and seminars - research and development, testing and technology demonstrations.
- Presentation module - conferences, teleconferences, forums.
- Observation module - lectures, library and 360° viewing platform.
- Central module - kitchen-dining room, mini-cafe, medical office.
- Residential modules - hotel rooms, mini gym and sauna.
- Technological modules - systems of autonomous life-support, storehouses and auxiliary premises.
- Hydrogen modules - systems of long-term energy storage.

Resource information:
www.aari.ru
www.arctic-mipt.com

SPAIN

SPAIN

Scientific research in the polar regions is especially important due to the global impact of the processes and discoveries taking place there, since they are privileged vantage points in many fields of knowledge.

In this regard we must consider, in the present situation, that the understanding, knowledge and observation of the geological, biological, oceanographic and atmospheric processes occurring in both the Arctic and the Antarctic are critical to the advancement of our knowledge of the Earth's land and ocean system processes.

Spain's involvement in research and in international Antarctic bodies, as well the fact that Spain has installations in and annually sends expeditions to that area, encompasses more than three decades, representing high levels of development, experience, and findings.

Nevertheless, Spanish scientific activity in the Arctic is more recent, and to date Spain has had a lower degree of involvement.

Due to their isolation, the need for specific infrastructures and complex logistics, scientific research in the polar regions requires a sufficient level of long-term financing, organization, stability and continuity.

The European Polar Board (EPB) is currently drafting an EPB Strategic Plan, within the framework of the EU Horizon 2020 research programme.

In the case of the Antarctic, the SCAR Antarctic Science Horizon Scan has identified the following issues as priority lines of scientific research for the upcoming decades:

- Better knowledge of the atmospheric characteristics of the polar regions and their interactions with climate in other latitudes and with global processes.
- Better understanding of variations in ice volume and their interactions with climate and sea level rise.
- Increasing our knowledge of the geology of the Earth's crust below the ice masses, to improve knowledge regarding the planet's geological functioning.
- Understanding the capacity to adapt and the evolutionary history of living Antarctic organisms.
- Leveraging the unique conditions of polar areas for space observation.
- Understanding anthropogenic impact, both direct and indirect, on the Earth's different ecosystems, especially on the Antarctic ecosystems, in order to lay the foundations for possible conservation measures.

In the case of the Arctic, the following must also be taken into consideration:

- The impact of climate change on human populations in the Arctic, including the necessary development of the social and human sciences in an inhabited area with extreme climate conditions and population subjected to fast-moving, radical changes in their environment.
- The natural resources and economic activities in an Arctic that is being profoundly influenced by climate change.

Spain shares these scientific objectives in both polar regions, considering polar research to be a strategic priority for the Spanish scientific system, both due to its scientific importance and to its high internationalization and repercussions in areas of interest to Spain, both strategically and socio-economically.

LOGISTICS

Land-based Spanish infrastructures in the polar regions are the Juan Carlos I Spanish Antarctic Base (known by the Spanish acronym BAE JCI), the Gabriel de Castilla Spanish Antarctic Base (BAE GdC), and the Byers Peninsula International Camp.

The Oceanographic Research Vessel Hespérides has a Lloyd Ice Class 1C hull, a classification for young ice, with the capacity to operate in the Antarctic and the Arctic.

The BAE JCI is managed by the Marine Technology Unit of Spain's National Research Council (UTM-CSIC), the BAE GdC by the Spanish Army, and the R/V Hespérides by the Navy.

The UTM-CSIC is in charge of the general logistics of each campaign, and of maintaining the scientific instruments not provided by the researchers and the time series of certain physical parameters.

Spain's Institute of Geology and Mining (IGME), in coordination with the Spanish Polar Committee, is responsible for the National Polar Data Centre.

Moreover, both in the Arctic and in the Antarctic, the operational potential offered by the EPB should be taken into account in sharing polar infrastructure, working in land and marine environments, and cooperating with the groups that manage the European polar fleet.

Consequently, Spain's priorities, from a short-to- medium-term logistical standpoint (2016-2025), can be summarized as follows.

Goals in the Arctic

- Facilitating Spanish researchers' access to land-based installations through the agreements necessary for exchanging scientific capabilities with other countries or institutions.
- Carrying out oceanographic campaigns.

SECTORAL ISSUES

Spain believes that the exploitation of resources in the polar regions and their transport must be carried out in a stable, sustainable and environmentally-friendly manner, likewise believing that a higher priority must be given to maintaining biodiversity and the living conditions of the local populations in these biologically unique areas with such extreme weather conditions.

Spain's sectoral interests in the polar regions encompass different areas of activity, related both to extractive activities and the available natural reserves, new navigable routes, commercial activity in the polar regions, and other fields related to the development of new technologies.

Photo: www.ciencia.gob.es

Resource information:

www.ciencia.gob.es

www.aei.gob.es

SWEDEN

SWEDEN

«Sweden will contribute, as one of the eight Arctic countries, to peaceful, stable and sustainable development in the Arctic. The Government wants to strengthen Sweden's Arctic profile by making use of the full range of knowledge and resources available in Sweden».

SWEDEN'S STRATEGY FOR THE ARCTIC REGION

Sweden is an Arctic country. Sweden therefore has a particular interest in and responsibility for promoting peaceful, stable and sustainable development and contributing to constructive international cooperation in the Arctic. As one of the eight Arctic countries, Sweden is a member of the Arctic Council.

The Arctic is facing both new opportunities and severe challenges. This applies especially to the dramatic climate and environmental changes. Global warming has hit the Arctic particularly hard, reducing the extent of ice and permafrost cover and affecting biodiversity and the living conditions of the region's population.

The indigenous peoples are particularly vulnerable. Climate change has also played a part in increasing the economic importance of the Arctic. The smaller ice cover creates new conditions for the use of natural resources and sea transport, for instance. The region's geostrategic importance has increased for both Arctic and non-Arctic states. Increased military presence and activity in the region have security policy consequences. COVID-19 has underlined the need for both resilience and preparedness in the local com- munities in the Arctic region to deal with pandemics.

Sweden has to take these changes in the Arctic into account. A Swedish core interest is to try to contribute to a peaceful, stable and sustainable development of the region through well-functioning international cooperation with Arctic and non-Arctic actors in the region. In both bilateral and multilateral settings, the Government will uphold an approach based on a broad concept of security. It is an overarching Swedish interest to uphold respect for international law and the rules-based world order, which form part of the foundations for international security and stability in the region. The Government will also contribute to achieving relevant global Sustainable Development Goals in the 2030 Agenda in the Arctic, too, and show leadership in the implementation of the international climate agreement (the Paris Agreement) to limit global warming, including in the Arctic.

The changes in the Arctic have also led to increased international interest in the region. Several countries in Europe and Asia have become observers to the Arctic Council. The European Union (EU) has strengthened its Arctic profile. The Government welcomes this development and takes a positive view of the possibility of mobilising increased international support and engagement to address the global challenges, in the Arctic region, in particular the impacts of climate change.

At the same time, it is in Sweden's interest to safeguard the special role and position of the Arctic states in promoting peaceful, stable and sustainable development in the Arctic region, mainly by strengthening cooperation in the Arctic Council.

This renewed strategy is intended to set out the Government's objectives and main priorities in relation to the Arctic region and to specify the political direction of further work on the Arctic in six thematic areas:

1. international collaboration;
2. security and stability;
3. climate and the environment;
4. polar research and environmental monitoring;
5. sustainable economic development and business interests;
6. securing good living conditions.

One important starting point for the strategy is to make use of the full range of knowledge and resources available in Sweden regarding the Arctic region to contribute to sustainable development in the Arctic and to enhance Sweden's profile as an important factor in this respect. For a long time, Sweden's engagement in the Arctic has involved not only the Government, the Riksdag and government agencies, but also regional and local authorities, indigenous peoples' organizations, higher education institutions, businesses and other actors in Sweden's Arctic region.

GLOBAL FRAMEWORK FOR SUSTAINABLE DEVELOPMENT AND CLIMATE WORK

The past decade has seen considerable development in the normative area of particular importance for managing global challenges such as the rapid climate change, and for working for economically, socially and environmentally sustainable development. Following extensive global negotiation processes, both the global agenda for sustainable development (the 2030 Agenda) and the international cli- mate agreement (the Paris Agreement) were adopted in 2015. These global frameworks are important starting points for Swedish engagement and international cooperation in the Arctic.

Sweden considers that Sweden should take a leading role in the global implementation of the 2030 Agenda, the global agenda for sustainable development. The 2030 Agenda contains 17 global goals (SDGs) and 169 targets for sustainable development. Several of them are particularly relevant to developments in the Arctic; examples are goal 12 Sustainable consumption and production, goal 13 Combating climate change and its impacts, goal 14 Sustainable use of the oceans, seas and marine resources and goal 15 Sustainable use of terrestrial ecosystems. In these matters, the Government calls for a high level of ambition in the implementation phase.

Sweden will also be a leader in the implementation of the Paris Agreement to limit global warming, including in the Arctic. One commitment made by the parties to the Paris Agreement is to keep the increase in global average temperature to well below 2°C above preindustrial levels. Preserving Arctic ice and permafrost is crucial in limiting global warming. Sweden has the objective that Sweden will be the world's first fossil-free welfare nation and that, by 2045, Sweden will not have any net emissions of green- house gases into the atmosphere.

In this context, the Government gives priority to the following thematic areas: international collaboration; security and stability; climate and the environment; polar research and environmental monitoring; sustainable economic development and business interests; and securing good living conditions.

Resource information:
www.polar.se
www.formas.se/en/start-page.html
www.vr.se/english.html
www.government.se

SWITZERLAND

SWITZERLAND

Switzerland's great commitment to the Arctic finds its origins in the nature of the Swiss landscape, which – like the Arctic – has been shaped by ice ages and is composed of mountain ranges with disappearing glaciers. Thus, the Swiss research community interweaves high-altitude with high-latitude knowledge. Its scientific excellence lies in the research on climate conditions and ecosystems in mountain and Polar Regions, e.g. to measure the impact of human-induced changes on the environment and the global climate.

Research has set interdisciplinary goals, which are achieved by means of international and multi-stakeholder collaborations, through international science programs such as in the framework of the International Arctic Science Committee (IASC). In 2017, Switzerland was granted the status of "Observer State" to the Arctic Council, in recognition of the country's long-standing commitments to research excellence and to peaceful international cooperation for the advancement of scientific knowledge and for the mitigation of the environmental and socio-economic impact of the changes happening in the Arctic.

ARCTIC RESEARCH

In Switzerland, research funding to institutions and individuals is awarded through a competitive system and according to qualitative assessment criteria. Mandated by the Swiss federal authorities, the Swiss National Science Foundation (SNSF) supports basic science in all academic disciplines. The government also provides funding to the research institutes within the Domain of the Federal Institutes of Technology as well as to thirty other research institutes.

Switzerland was fully associated to Horizon 2020 and is linked to the climate and polar topics currently underway. Swiss researchers contribute significantly to flagships scientific projects of the EU Research Framework Programs, such as Beyond EPICA (search for oldest ice on Antarctica to re-construct climate history) and CHARTER (drivers and feedbacks of changes in Arctic terrestrial biodiversity).

The Swiss Polar Institute (SPI), established in 2016, offers funding to researchers to complement the available SNSF funding to cover logistical and fieldwork expenses. SPI also funds Swiss participation in international initiatives such as MOSAiC or ICE Memory and organizes scientific expeditions with international participation as well as health and safety training courses. The SPI further performs targeted research expeditions.

It represents Switzerland in Arctic logistics organizations such as FARO and takes part in EU PolarNet.

The Swiss Committee on Polar and High-Altitude Research (SCPHAR), of the Swiss Academies of Arts and Sciences, coordinates the polar and high-altitude research community. In addition, it represents Switzerland in international scientific organizations, such as IASC.

MAJOR ARCTIC RESEARCH

The Swiss Arctic science landscape is very diverse, with scientific activities spreading over thirteen academic institutions in areas such as glaciology, climatology, atmospheric sciences, biology, geophysics, geology and ethnology. Four research foci were identified in the Swiss Polar Institute's Science Plan, based on current strength of the science community and future research topics:

1. Cryosphere through time – processes, feedbacks and responses.

2. The carbon, nitrogen, water cycle nexus – past, present, future.

3. Biodiversity and ecosystem functions.

4. Technology in extreme environments.

Further, an increasing interest of the social sciences and humanities in Arctic research is developing. A selection of recent and future research activities is highlighted below:

Arctic Century Expedition. The Swiss Polar Institute is collaborating with Geomar (Germany) and AARI (Russia) for an interdisciplinary expedition to the northern Russian islands in the Kara Sea.

MOSAiC. During the one-year-long Multidisciplinary drifting Observatory for the Study of Arctic Climate expedition (2019-2020), Swiss scientists focused on atmospheric studies, snow observations and sea ice remote sensing, contributing to three major themes of the expedition.

IPICS 2021. Polar and high-altitude ice cores provide unique information about past climate and environmental conditions as well as direct records of the composition of the atmosphere on timescales from decades to hundreds of millennia. In October 2022, Switzerland hosted the third Open Science Conference of the International Partner- ships for Ice Core Sciences (IPICS).

WGMS. For more than a century, the World Glacier Monitoring Service (WGMS) and its predecessor organizations have compiled and disseminated standardized data on glacier fluctuations. The WGMS annually collects glacier data through its scientific collaboration network active in more than 30 countries.

Photo: www.eda.admin.ch / Swiss Camp on the Greenland Ice Sheet

Resource information:
www.swisspolar.ch
www.polar-research.ch/de

UNITED KINGDOM

THE UNITED KINGDOM

The United Kingdom is one of the leading nations in Arctic research with over 70 universities and research centers that carry out work in the biological, physical, geological and social sciences. Understanding the pace of change in this region, including the local and global impact, is more important than ever.

Our work aims to highlight the breadth and depth of UK Arctic Research with a searchable Projects Database to come that will contain information about funded UK research projects from across the Arctic. We also highlight key international programmes with a high level of UK involvement, and include links to NERC's two big Arctic programmes – the recently completed NERC Arctic Research Programme and the recently funded NERC Changing Arctic Ocean Programme. By identifying opportunities for international engagement and cooperation, we aim to further promote UK Arctic research at the highest levels.

Canada-Inuit Nunangat-United Kingdom Arctic Research Programme 2021 – 2025 (CINUK)

On the 11th of May 2022, the CINUK programme partners – Inuit Tapiriit Kanatami (ITK), United Kingdom Research and Innovation (UKRI), Polar Knowledge Canada (POLAR), National Research Council of Canada (NRC), Parks Canada (PARKS), and the Fonds de Recherche du Quebec (FRQ) – announced the 13 successful projects funded under the *Canada-Inuit Nunangat-United Kingdom Arctic Research Programme* in support of key themes connected to climate-driven changes to the terrestrial, coastal and near-shore marine environments in Inuit Nunangat, as well as the impacts on Inuit and community health and well-being.

MOSAiC

The Multi-Disciplinary drifting Observatory for the study of Arctic Climate programme (MOSAiC) is the first year-round expedition into the central Arctic Ocean to explicitly study the Arctic climate system.

Led by AWI in Germany, in close cooperation with AARI in Russia and the University of Colorado in the United States, with participation from many other countries, it offers the opportunity to make a step-change in in-situ observations and contribute to understanding the regional and global consequences of Arctic change. Starting in October 2019, the expedition will see the RV Polarstern frozen into the Arctic sea ice and then drift across the top of the Arctic Ocean, conducting an enormous range of marine, atmospheric, biological and other research from the floating platform, field camps and advanced remote and autonomous vehicles.

Cross-Whitehall Arctic Network

The NERC Arctic Office is a member of the Cross-Whitehall Arctic Network, a group of representatives from Government departments and agencies. The group meets around twice a year to discuss Arctic policy matters, share information and updates, and identify emerging issues and opportunities. The group is chaired by the Polar Regions Department, FCO. The NERC Arctic Office role is to ensure that we maximize the opportunities for UK-based researchers through identifying and following through on new connections, as well as providing science to policy advice directly, as well as through suggesting engagement with key experts.

Photo: www.arctic.ac.uk

Photo: www.arctic.ac.uk

All Party Parliamentary Group on the Polar Regions

This is an informal group established to inform and educate MPs and Peers on polar issues. The APPG is chaired by James Gray MP. It hosts regular meetings in Parliament which are open to non-Parliamentarians on a very broad range of issues connected with the polar regions, including tourism, climate change, expeditions, security and governance, commercial engagement and many more. The NERC Arctic Office and the British Antarctic Survey were pleased to be able to host a visit from the Group to the UK Arctic Research Station in Ny-Alesund in August 2017. We work closely with the APPG to support their interests and engagement in Arctic issues and connect researchers to policy and decision-makers. Henry Burgess, the Head of the NERC Arctic Office, is a member of the Group's Advisory Council.

IASC Action Group on Communicating Arctic Science to Policy Makers

The NERC Arctic Office is part of a new IASC Action Group, which will make recommendations to the IASC Council on how best to communicate Arctic science to policy makers. Working alongside colleagues from Poland, Germany, Korea, United States, Norway, the aim is to help focus on the opportunities to present the reality of Arctic science programmes and initiatives to the wider community.

Resource information:

www.arctic.ac.uk

UNITED STATES OF AMERICA

UNITED STATES OF AMERICA

Arctic Research Plan 2022–2026

Building on the successes and communities of practice of the 2017–2021 plan, the new Arctic Research Plan 2022-2026 is a bold strategy for a changing Arctic. It outlines a vision for federal agencies to address emerging research questions about this vital region, and provides pathways to strengthen relationships between federal agencies and Indigenous communities, academia and non-federal researchers, the state of Alaska, nonprofits, and private sector and international organizations.

Biennial Implementation Plan 2022-2024

The Arctic Research Plan is a high-level strategy for the next five years. Its overarching goals will be accomplished through biennial implementation plans with specific objectives and deliverables.

The Biennial Implementation Plan 2022-2024 provides specific actions that IARPC and its member agencies will take to promote research aimed at improving community resilience and well-being, advancing scientific understanding of ongoing changes in the Arctic system, creating more sustainable economies and livelihoods, and improving risk management and hazard mitigation.

Putting the Plan into Practice: Collaboration Teams and Communities of Practice

The Arctic Research Plan 2022-2026 presents a research framework with thematic goals. It seeks to address critical areas for which an interagency approach can accelerate progress, but it does not attempt to address all federally funded research in the Arctic.

Progress toward the goals, objectives, and deliverables of the Arctic Research Plan and Biennial Implementation Plan is led by collaboration teams and communities of practice organized via IARPC Collaborations.

Priority Areas

The four priority areas represent areas of broad, crosscutting research focus. Teams include:

- **Community Resilience and Health**

Goal: Improve community resilience and well-being by strengthening research and developing tools to increase understanding of interdependent social, natural, and built systems in the Arctic.

- **Arctic Systems Interactions**

Goal: Enhance our ability to observe, understand, predict, and project the Arctic's dynamic interconnected systems and their links to the Earth system.

- **Sustainable Economies and Livelihoods**

Goal: Observe and understand the Arctic's natural, social, and built systems to promote sustainable economies and livelihoods.

- **Risk Management and Hazard Mitigation**

Goal: Secure and improve quality of life through research that promotes an understanding of disaster risk exposure, sensitivity to hazard, and adaptive capacity.

Foundational Activity & Collaboration Teams

Foundational activities are critical in supporting the priority areas in this plan, as well as a robust research program in the Arctic. The foundational activities are expected to continue beyond this plan.

1. Data Management
2. Education, Training, and Capacity Building
3. Monitoring, Observing, Modeling, and Prediction
4. Participatory Research and Indigenous Leadership in Research
5. Technology Application and Innovation

Photo: www.arctic.gov

Communities of Practice

Priority areas and foundational activities are supported by robust communities of practice. These are:

1. Atmosphere
2. Field Operations
3. Marine Ecosystems
4. Permafrost
5. Terrestrial Ecosystems
6. Diversity and Inclusion
7. Health & Well-being
8. Observing
9. Sea Ice
10. Coastal Resilience
11. Glaciers & Sea Level
12. Modeling
13. Physical Oceanography

Arctic Renewable Energy Working Group

The US Arctic Research Commission coordinates the Arctic Renewable Energy Working Group (AREWG) to promote research on renewable and efficient energy systems in remote Arctic communities. Integration of renewable resources and supporting technologies into a community's current power generation capacity has the potential to generate local employment, decrease air pollution and carbon footprint, and ideally reduce consumer costs. Energy efficiency and conservation are critical components of this effort.

The Working Group's mission is to benefit Arctic communities by identifying and addressing critical renewable energy and energy efficiency research needs.

Areas of Focus

- New options for home heating and electricity aimed at increasing energy efficiency/use of renewable energy and reducing heating oil consumption
- Storage of energy produced by renewables, with particular focus on improved battery technology
- Indirect community benefits of renewable and efficient energy use that do not get figured into typical renewable energy cost/benefit analyses
- Increasing potential for industry investment in remote renewable energy projects (decreasing uncertainty by identifying and mitigating risk)
- Energy equity

Resource information:

www.iarpccollaborations.org
www.arctic.gov

GWICH'IN COUNCIL INTERNATIONAL

Gwich'in Council INTERNATIONAL

Gwich'in Council International (GCI) represents 9,000 Gwich'in in the Northwest Territories (NWT), Yukon, and Alaska as a Permanent Participant in the Arctic Council; the only international organization where Indigenous peoples have a seat at the decision-making table alongside national governments. GCI supports Gwich'in by amplifying our voice on sustainable development and the environment at the international level to support resilient and healthy communities. Gwich'in Council International participates in a number of different projects to advance our goals.

PROJECTS

1. ENERGY TOOLKIT

The Arctic Sustainable Energy Futures Toolkit is a guide for communities to follow when developing their comprehensive community energy plans. This step-by-step toolkit will transfer knowledge using best practices, resource guides, case studies, videos, worksheets, and templated pathways to help communities create and implement their energy visions. In addition, the Toolkit provides resources to increase energy literacy and capacity for community members build bridges between communities and agency officials and subject matter experts, and create a network of circumpolar community energy leaders.

Through the development of the Arctic Energy Futures Toolkit, communities will:

- Project the short and medium term energy demand trends and requirements in their region;
- Understand the impacts of diesel power reliance and supply constraints on social conditions, the environment, and economic development in their region;
- Identify options for energy demand reductions, enhanced productivity for diesel systems, energy efficiency, and renewable energy;
- Review off-grid, microgrid and regional grid examples from around the Arctic;
- Create wise and creative energy planning processes for the Arctic through community visioning and by examining lessons learned and pre-existing solutions;
- Work collaboratively with other communities that are creating their Sustainable Energy Futures Plans; and
- Prepare a Sustainable Energy Futures Plan through research and discussions between government and partner organizations with the aim of putting the plan into action and securing adequate capital and capacity for implementation.

2. Arctic Environmental Impact Asessments

Good Practice Recommendations for Environmental Impact Assessment and Public Participation in the Arctic

The objectives of the project are:

- To ensure that environmental considerations specific to the Arctic including social and health aspects, are explicitly addressed and incorporated into the planning, design and decision making of large-scale economic projects.
- To identify existing good practices through sharing and learning with the aim of developing good practice recommendations for EIA in the Arctic.
- To promote meaningful practices of public participation, especially the participation of indigenous peoples, and the integration of traditional and local knowledge in EIA within the Arctic.
- To build a viable network of Arctic EIA actors.

3. ARENA

Arctic Renewable Energy Network Academy (ARENA)

The Arctic Remote Energy Networks Academy (ARENA) program focuses on sharing knowledge and establishing professional networks related to microgrids and integration of renewable energy resources for remote Arctic communities. In 2017, the Arctic Remote Energy Networks Academy (ARENA) pilot program brought together 17 individuals from three Arctic states and three Arctic Permanent Participant organizations for a combination of training, mentoring and site visits.

There was great feedback and learning from the program, and we are excited to deliver another one. ARENA-II was approved at the September 2019 SDWG meeting to support a second cohort focused on sustainable energy solutions for remote Arctic communities.

4. Food Producing Region

Arctic as a Food Producing Region

The aim of this project is to assess the potential for increased production and benefit of food from the Arctic, with the overarching aim of improving economic and social conditions of Arctic communities. The Arctic or northern areas are already important as a food producing region, but has potential to become even bigger. By focusing on biological (climate change), industry (commercial resources, infrastructure and industry policy) and market conditions the project will explore and describe possible paths of development for arctic food production. The aim is to identify conditions for increased production, new species and last but not least the potential for benefit of food from the Arctic.

The project is led by Norway, with the support of Canada, Iceland, and the United States.

5. Wildland Fire

Wildland fires are increasing in frequency, severity, and area across the Arctic, bringing challenges as well as opportunities and requiring greater collaboration, knowledge sharing, and partnership. Gwich'in Council International (GCI) is leading two projects to advance work on wildland fires at the Arctic Council, in the CAFF and EPPR Working Groups. Additionally, there is work in other Arctic Council Working Groups (AMAP and ACAP).

Each project has unique objectives and intended uses, as well as its own Steering Committee of State, Permanent Participant, and Observer representatives.

The projects are connected through their overarching goal of addressing wildland fires in the Arctic and circumpolar focus. Knowledge sharing is a key component of both projects, and a workshop is planned (2022) to bring people working in ecology, management, and response together and review draft project deliverables.

6. Local 2 Global

Youth Digital Stories and Community Exchange

Gwich'in Council International (GCI) is a Permanent Participant at the Arctic Council, a forum for cooperation and collaboration in the circumpolar north. GCI works to amplify the voice of the Gwich'in Nation on issues of sustainable development and the environment, and we look for opportunities to connect community priorities and needs with what is happening across the Arctic.

One shared priority is mental health and wellbeing, recognizing the devastating impacts of suicide particularly among youth. Building on the work of the Arctic Council, and its Sustainable Development Working Group (SDWG), we wanted to use materials (films) already created as an anchor to wellness events. It was also important that youth be not only involved as participants but central in the design and delivery, and supported in leadership roles.

We collaborated with the Western Arctic Youth Collective (WAYC), and contracted them to imagine, plan, and deliver events, as well as document their learnings, share recommendations, and create a guide for other youth groups to take on similar events. We also established an Advisory Committee to support the work.

We are pleased to share the outcomes and materials with the goals of informing and enabling future work. We encourage others to use this delivery model and collaborate with youth in meaningful ways, which will build capacity, skills, relationships, and partnerships.

Resource information:
www.gwichincouncil.com/

THE INUIT CIRCUMPOLAR COUNCIL

INUIT

The Inuit Circumpolar Council (ICC) is an international, Indigenous non-governmental organization founded by the late Eben Hopson, Sr. from Utqiagvik, Alaska in 1977, representing approximately 180,000 Inuit of Alaska, Canada, Greenland, and Chukotka (Russia). The organization holds Consultative Status II at the United Nations Economic and Social Council and is a Permanent Participant at the Arctic Council. Applications are awaiting approval for consultative status at the International Maritime Organization (IMO) and for observer status at the Intergovernmental Panel on Climate Change (IPCC).

To thrive in their circumpolar homeland, Inuit speak with a unified voice on issues of common concern and combine their energies and talents towards protecting and promoting their way of life. ICC works collectively to address issues of concern to Inuit and is guided by Indigenous Knowledge1 (IK). Recognizing that both IK and science are necessary for building evidence-based information for use in decision-making and policy, much of our work aims to bring together these distinct knowledge systems.

Current ICC activities and programs related to IK and science focus on food security, food sovereignty, wildlife management, economic development, education, climate change, contaminants, biodiversity, shipping, use of Arctic waterways, Inuit health and well-being, information sovereignty, and monitoring.

An important national and global priority is addressing food security and food sovereignty. The Circumpolar Inuit Wildlife Committee promotes, develops and maintains Inuit rights to self-determination and their culture, food sovereignty and sustainable use by providing a unified pan-Arctic Inuit voice concerning access, sharing, and management of wildlife resources.

Our 2020 report on Food Sovereignty and Self-Governance*: Inuit Role in Managing Arctic Marine Resources* builds on our Alaskan *Inuit Food Security Conceptual*.

Framework: How to Assess the Arctic From an Inuit Perspective and aids in educating and directing research to apply a holistic (ecosystem based) approach to understanding the Arctic.

These reports provide important indicators for ecosystem health, food security, and food sovereignty. Within the wealth of information put forward by Inuit through these two reports, the interconnectivity between every- thing within the Arctic, understanding people as part of the ecosystem, is stressed. This work has aided ICC in encouraging national and international research and monitoring initiatives to take on a holistic food security approach to monitoring and understanding the Arctic. Both reports are crucial resources for discussions and actions on climate change, biodiversity, language, health, monitoring, self-determination, cumulative effects and the need to take on holistic approaches by bringing together Indigenous Knowledge and science.

This work has aided ICC's efforts in multiple international forums, such as the Sustainable Arctic Observing Network (where we have encouraged and educated on how to apply a food security approach to monitoring); the Convention on Biological diversity (where we have utilized the indicators and important points stressed through these reports to provide feedback and direction within the development of the Post 2020 Global Biodiversity Framework); within the Coastal Expert Monitoring Group, an initiative under the Arctic Council's Conservation of Arctic Flora and Fauna working group (where we have developed a platform that will support a co-production of knowledge approach through bringing together Indigenous Knowledge and Science).

ICC works at many levels to advocate for environmental stewardship and has brought the vision of Inuit led management and monitoring to the international community. ICC maintains a strong voice, bringing attention to the human dimensions of climate change on an international level, providing contributions to research and policy. For example, in 2008, ICC produced the report '*The Sea Ice is our Highway: An Inuit Perspective on Transportation in the Arctic*' for the Arctic Marine Shipping Assessment.

More recently, ICC is working to define and implement international regulations and is working with signatory nations to build Indigenous Knowledge into science programme of an international treaty to take a precautionary approach to commercial fisheries in the Central Arctic Ocean. ICC is engaged with monitoring initiatives through national programmes, Arctic Council initiatives, and the Sustaining Arctic Observing Networks (SAON). Under SAON, ICC and partners created the online Atlas of Community-Based Monitoring (CBM) & Indigenous Knowledge in a Changing Arctic. The atlas is a searchable inventory that maps CBM projects across the circumpolar Arctic. The atlas was expanded to include Inuit mental health and wellness programs.

ICC is participating in the expert review of the 6th IPCC assessment report draft chapters, providing input to the Polar Regions cross-chapter lead authors and has contributed a section written in first-person by Indigenous Peoples.

Contaminants and pollutants have accumulated in the Arctic environment and have magnified up the food chain, a concern amongst Inuit community for decades. Our concerns are further amplified with the increasing amount of long-range transport of contaminants and pollutants into the Arctic from across the globe, including (micro-) plastics, thawing permafrost, and the continued threat of persistent organic pollutants (POPs) and mercury. Therefore, ICC has been actively engaged in the negotiations and implementation of United Nation conventions addressing some of these contaminants, such as the Stockholm Convention on POPs and the Minamata Convention on Mercury.

Contaminants Program and the Arctic Council's Arctic Monitoring and Assessment Programme (AMAP). ICC is involved in these monitoring activities, and co-authors and reviews associated assessment reports. Examples include the *AMAP Assessment 2015: Human Health in the Arctic* and the *2011 AMAP Assessment on Mercury in the Arctic*.

As shared above, our work is strongly guided by IK. While there is growing awareness of the importance of IK, a continued top down approach has created a gap where institutional inequities inhibit meaningful involvement of Indigenous peoples that can provide direction on how to meaningfully engage this important knowledge system and ensure inclusion of Indigenous communities. There is a pressing need for institutions to adapt in order to understand and address challenges across scales. This adaptation requires the involvement and utilization of IK, along with science, to inform circumpolar research, assessments, observation/monitoring programs and governance.

In response to these challenges, ICC will facilitate the development of Circumpolar Inuit protocols/guidelines for equitable, ethical engagement and involvement of Indigenous Knowledge and communities. The first phase of this work has resulted in a synthesis report of Inuit rules, guidelines, protocols and values that guide the engagement of Inuit communities and our knowledge. The final product will be used to develop a proposed process, outline for the Arctic Council, and provide a specific example tailored to one of the six working groups. The process will be used in other forums, such as the Intergovernmental Policy on Biodiversity and Ecosystem Services. The results will ultimately be made available to all nations with an interest in the Arctic. This work will also further aid in advancing efforts in bringing together Indigenous Knowledge and science through a co-production of knowledge approach.

Resource information:
www.inuitcircumpolar.com/

SAAMI COUNCIL

The Saami Council is a voluntary Saami organization (a non–governmental organization), with Saami member organizations in Finland, Russia, Norway and Sweden. Since it was founded in 1956, the Saami Council has actively dealt with Saami policy tasks.

PROJECTS

1. FILLING THE EU-SÁPMI KNOWLEDGE GAPS

The Saami Council member organizations have over time expressed a need for more knowledge and exchange of experience in Sápmi on how EU directives, regulations, decisions, opinions and recommendations affect the everyday life of the Sámi people. The need has also been raised in the Sámi Parliamentary Council (SPR) for a long time on how Sámi can get a clearer voice within the EU and how a permanent contact point with the EU can be organized. The project is rooted both at the political level in Sápmi and in civil society.

In September 2019, the Saami Council in partnership with the Suoma Sámi Nuorat received funding from the EU Interreg Nord program for the project filling the EU-Sápmi knowledge gaps. The overall aim of the project is to strengthen the relationship between Sápmi and the EU, through creating a knowledge platform on EU-Sámi relevant topics but also to develop a strategic approach towards the EU. The project has four main activities, including a trainee program, a module based course on relevant EU-Sápmi topics, a pilot Sámi Week in Brussel in 2022 as well as the establishment of an EU-Sámi think-tank of Sámi experts.

The project is funded by Interreg Nord, Regional Council of Lapland, Sámi Parliament in Norway, County Municipality of Troms and Finnmark, Region Norrbotten, and Region Västerbotten.

2. EU-SÁMI WEEK 2022

The aim of EU-Sámi Week was to strengthen the relationship between Sápmi and the EU. EU-Sámi Week was the first step in raising awareness among EU decision-makers about the need to include the Sámi people in EU policymaking. Because the EU is involved in many sectors that have an impact on the Sámi way of life, such as climate and environment, agriculture, education, culture, and research, it is natural that relations are strengthened. The week was expected to become a recognized platform for political communication between the EU and the Sámi people in the future.

The event was a networking platform for experts in regional and local development through the lens of the Sámi people. Exchange of good practices in economic development and social inclusion, cross-border cooperation, regional innovation, and community-led local development was in focus.

3. KULTURSÁPMI

KulturSápmi is a meeting place for the cultural and artistic field in Sápmi to discuss current teams, work in progress and so forth. The main objective is to build cross-border networks, develop the cultural field as one field and motivate more cooperation.

The first KulturSámpi was held in Kiruna 16–17th of October 2019. Collaborative partners were The Sámi parliaments, Innovation Norway and Giron Sámi teáhter.

KulturSápmi is a non-political conference and we invite everyone who works with culture in Sápmi to bring input to the conference program: exciting art in progress, current topics or what do you need more knowledge about?

Photo: www.saamicouncil.net/en/home/

4. EU-SÁMI YOUTH IDEA LAB

The EU-Sámi Youth Idea Lab will come up with ideas on how to increase Sámi Youth participation in EU youth initiatives and decision-making.

The objective of the EU-Sámi Youth Idea Lab project is to raise awareness among Sámi Youth about EU policies and give youth the chance to engage actively and participate in finding solutions to making their voices heard in the EU. The project's outcome will be a recommendation from Sámi youth to the EU on how to increase Sámi youth participation in EU decision-making. Topics for the Idea Lab will be EU youth initiatives and traineeship programs. The project is a part of the Saami Council's AWARE-project funded by the European Union.

Photo: www.saamicouncil.net/en/home/

Resource information:
www.saamicouncil.net/en/home/

AMAP

The Arctic Monitoring and Assessment Programme is one of six Working Groups of the Arctic Council.

AMAP is mandated:

- To monitor and assess the status of the Arctic region with respect to pollution and climate change issues.
- To document levels and trends, pathways and processes, and effects on ecosystems and humans, and propose actions to reduce associated threats for consideration by governments.
- To produce sound science-based, policy-relevant assessments and public outreach products to inform policy and decision-making processes.

AMAP's work is directed by the Ministers of the Arctic Council and their Senior Arctic Officials, who have requested AMAP to also support international processes that work to reduce the global threats from contaminants and climate change. These include the UN Framework Convention on Climate Change, UNEP's Stockholm Convention on Persistent Organic Pollutants and Minamata Convention on mercury, and the United Nation's Economic Commission for Europe (UN ECE) Convention on Long-range Transboundary Air Pollution.

Since its establishment in 1991, AMAP has produced a series of high quality reports and related communication products that detail the status of the Arctic with respect to climate and pollution issues and that include policy-relevant science-based advice to the Arctic Council and governments.

CURRENT PROJECTS

1. Microplastics and Litter in the Environment

AMAP is currently preparing the first monitoring plan on microplastics and litter in the entire Arctic ecosystem.

Concerns about microplastics and litter in the environment have been raised at global (Convention on Biological Diversity, UN Environment Programme) and regional levels (Arctic Council Ministerial Meetings, EU, Convention for the Protection of the Marine Environment of the North-East Atlantic, Nordic Council).

In 2017, AMAP released an assessment on *Chemicals of Emerging Arctic Concern* in which Marine plastics, microplastics and their toxicity were examined, and identified as an emerging research area in the Arctic.

The same year, the Nordic Ministers took the decision to launch a Nordic programme to reduce the environmental impact of plastic pollution in the Arctic. PAME, Protection of the Arctic Marine Environment, a working group of the Arctic Council, conducted a *Desktop Study on Marine Litter including Microplastics in the Arctic,* the first Arctic-wide study on the impacts of plastic pollution. The conclusion of this work underscored the necessity to create a Regional Action Plan on marine litter in the Arctic.

The Regional Action Plan has now been approved. It focuses on Arctic-specific plastic and litter sources and pathways. AMAP supports this effort focusing on the monitoring aspect of the growing issue of litter and microplastics.

AMAP's Expert Group on Microplastics and Litter

AMAP has a mandate to monitor and assess the status and trends of contaminants in the Arctic. In the Spring of 2019, AMAP decided to step up its efforts on the plastic issue and established an Expert Group on microplastics and litter. The Expert Group aims to:

- Design a program for the monitoring of microplastics and litter in the Arctic environment.
- Develop necessary guidelines supporting the monitoring program.
- Formulate recommendations and identify areas where new research and development is necessary from an Arctic perspective.

The current leads of the Expert Group on Microplastics and Litter can be found under Contacts (see below). AMAP maintains a list of members of its expert groups who are nominated through an open process and contribute to this work in their capacity and independent experts. All AMAP reports are subject to an independent peer-review process.

AMAP's Microplastics and Litter Monitoring Plan and Monitoring Guidelines

AMAP and the Expert Group has developed a comprehensive monitoring plan and technical guidelines for monitoring microplastics and litter in the Arctic. It is the first time that all parts of the Arctic ecosystem are examined for traces of this type of pollution:

- Overview of AMAP Initiatives for Monitoring and Assessment of Plastic Pollution in the Arctic
- AMAP Litter and Microplastics Monitoring Plan
- AMAP Litter and Microplastics Monitoring Guidelines. Version 1.0

While the Regional Action Plan is focused on the marine environment, AMAP's Expert Group is interested in monitoring and assessing the presence and effects of litter and microplastics in the air, in rivers, lakes, on land, all the way to the bottom of the sea.

Photo: www.amap.no

Photo: www.amap.no

2. Mercury in the Arctic

Mercury pollution represents a threat to Arctic wildlife and human populations.

Mercury is a global environmental contaminant with both natural sources and sources associated with human activities; much of the mercury contaminating the Arctic is a result of transport by air and ocean pathways from sources outside of the Arctic.

Mercury is bioaccumulated and biomagnified in Arctic food chains. This can result in high levels of mercury in top predators such as polar bears and toothed whales. Humans, especially some indigenous populations that rely on marine mammals as part of their traditional diet, can receive high dietary exposure, raising concerns about possible effects on human health.

3. POPs – Climate change Interactions

Bioaccumulation and toxicity: POPs can bioaccumulate in Arctic food webs and, due to their persistence and tendency to associate with lipids, many biomagnify in food chains. High levels of POPs in species that are high in the food chain (especially in marine food-webs) lead to exposure to these chemicals by certain animals and people that consume these species as part of their subsistence diets. This, together with the toxic properties of many POPs, raises concerns for both human and wildlife health.

Changing climatic conditions in the Arctic are leading to changes in ecosystems. Some species are challenged by the changes that are occurring, such as species that rely on sea ice habitats; others are moving in to areas where conditions are now more hospitable. Changes in species composition, and phrenology (timing of events) is resulting in changes in ecosystem structures. If species start to change their diets this can introduce new steps in biomagnificaiton characteristics that determine POPs levels in animals, potentially increasing or decreasing levels of exposure by several orders of magnitude.

AMAPs work on climate-chemical interactions and its relevance to international processes that aim to reduce global POPs contamination.

4. SAON

The SAON Vision is that users should have access to free, open and high quality data that will realize pan-Arctic and global value-added services and provide societal benefits.

5. AMAP'S LONG TERM PROGRAMME ON RADIOACTIVITY

AMAP has established a radioactivity Expert Group that compiles and assesses data and information arising from the monitoring and other relevant research activities in the Arctic.

AMAP maintains a list of members of its expert groups who are nominated through an open process and contribute to this work with their expertise as independent experts. All AMAP assessments are subject to an independent peer-review process.

6. AMAP's LONG TERM PROGRAMME ON CLIMATE

AMAP's contributions to international initiatives on climate

Concerns about the impact of climate change on the Arctic ecosystems and populations have been communicated to both the Arctic Council and to the international community. AMAP contributes to the IPCC reports (Intergovernmental Panel on Climate Change), including their special reports.

Long-term programme on climate

AMAP has established a Climate Expert Group that compiles and assesses data and information arising from the AMAP monitoring programme and other relevant research and monitoring activities.

The current leads of the AMAP Climate Expert Group can be found under Contacts (see below), and AMAP maintains a list of members of its expert groups who are nominated through an open process and contribute to this work in their capacity and independent experts. All AMAP assessments are subject to an independent peer-review process.

AMAP's Climate Assessment work will include an assessment of the societal impacts of climate change in Arctic communities. AMAP is also working alongside CAFF (Working Group on Conversation of Arctic Flora and Fauna) on a new assessment of climate change and its impacts on Arctic ecosystems and ecosystem feedbacks.

Resource information:
www.amap.no

ASSOCIATION OF POLAR EARLY CAREER SCIENTISTS

The Association of Polar Early Career Scientists (APECS) is an international and interdisciplinary organization for undergraduate and graduate students, postdoctoral researchers, early career faculty members, early career professionals, educators and others with interests in Polar and Alpine regions and the wider cryosphere.

APECS Goals and Objectives

APECS' goals include creating opportunities for the development of innovative, international, and interdisciplinary collaborations among current early career polar researchers as well as recruiting, retaining and promoting the next generation of polar enthusiasts. Specifically we aim to:

- Create a network of polar researchers across disciplines and national boundaries to meet, share ideas and experiences, and develop new research directions and collaborations
- Provide the opportunity for career development for both traditional and alternative polar and cryosphere professions
- Promote education and outreach as an integral component of polar research and to stimulate future generations of polar researchers

Project Groups

Project groups are small working groups led by Project Group Leaders. Ideas such as Polar Weeks, the APECS Mentorship Award, and the many workshops and panel discussions, have all started with a few talented people working together with a specific aim - to help each other and to create a better way to conduct polar research and to help others learn about it. APECS Project Groups are how new ideas become reality.

Resource information:

www.apecs.is

National Committees

APECS has many different groups to get involved with, and for many people connecting with other young researchers in their own country is a first step to meeting new colleagues and getting involved. Some countries have well developed APECS National Committees, some are just getting started - and others are just a mailing list of all the APECS members in that country.

APECS STRATEGIC PLAN 2021-2025

The Strategic Plan is a result of discussions among the APECS Leadership (Executive Committee, Council and APECS Directorate), the APECS National Committees, and extensive consultation with the wider APECS membership and polar research community.

It includes recommendations of the APECS Organizational Review 2019 and identifies development opportunities for APECS through six main Strategic Goals:

1. Expansion and Support for Membership
2. Improving Communication
3. Strengthening National Committees & Global Connections
4. Establish a Structure to Grow Sustainably & Improve Internal Functions
5. Advancing Connections through Virtual and In-person Events
6. Maintaining & Building Partnerships

The APECS Strategic Plan 2021-2025 was written by the 2019-2020 APECS Executive Committee, with the help of the International Directorate and the APECS Council. We wish to express our sincere gratitude to everyone who provided feedback during the process.

We look forward to working with our members, National Committees, partners and sponsors to help us implement the Strategic Plan. It will provides APECS with a framework in providing opportunities for early career scientists and fostering a continuum of leadership in the polar and wider cryospheric sciences.

APECS

APECS NL
Association of Polar Early Career Scientists

CAFF

CAFF is the biodiversity-working group of the Arctic Council and consists of National Representatives assigned by each of the eight Arctic Council Member States, representatives of Indigenous Peoples' organizations that are Permanent Participants to the Council, and Arctic Council observer countries and organizations. The CAFF Working Group operates by the Arctic Council Rules of Procedures.

CAFF serves as a vehicle to cooperate on species and habitat management and utilization, to share information on management techniques and regulatory regimes, and to facilitate more knowledgeable decision-making. It provides a mechanism to develop common responses on issues of importance for the Arctic ecosystem such as development and economic pressures, conservation opportunities and political commitments.

What does CAFF do?

CAFF's mandate is to address the conservation of Arctic biodiversity, and to communicate its findings to the governments and residents of the Arctic, helping to promote practices which ensure the sustainability of the Arctic's living resources. It does so through various monitoring, assessment and expert group activities.

CAFF's projects provide data for informed decision making to resolve challenges arising from trying to conserve the natural environment and permit regional growth. This work is based upon cooperation between all Arctic countries, indigenous organizations, international conventions and organizations, and is guided by the CAFF Strategic Plan for the Conservation of Arctic Biological Diversity and biennial Work Plans.

To successfully conserve the natural environment and allow for economic development, comprehensive baseline data is required, including the status and trends of Arctic biodiversity, habitats and ecosystem health. CAFF is developing the framework and tools necessary to create a baseline of current knowledge, and to provide dynamic assessments over time. This evolving, sustainable and responsive approach can produce more regular, timely and flexible analyses.

Circumpolar Biodiversity Monitoring Programme (CBMP)

The Circumpolar Biodiversity Monitoring Program (CBMP) is an international network of scientists, governments, Indigenous organizations and conservation groups working to harmonize and integrate efforts to monitor the Arctic's living resources.

Our goal is to facilitate more rapid detection, communication, and response to the significant biodiversity-related trends and pressures affecting the circumpolar world.

The CBMP organizes its efforts around the major ecosystems of the Arctic: marine, freshwater, terrestrial and coastal. The CBMP works to leverage monitoring activities of networks and nations and establish international linkages to global biodiversity initiatives. The CBMP emphasizes data management (through the Arctic Biodiversity Data Service), capacity building, reporting, coordination and integration of Arctic monitoring, and communications, education and outreach.

The CBMP has been endorsed by the Arctic Council and the UN Convention on Biological Diversity and is the official Arctic Biodiversity Observation Network of the Group on Earth Observations Biodiversity Observation Network (GEOBON).

CAFF Assessments

CAFF assessments describe the current state of Arctic ecosystems and wildlife using the best available scientific and Traditional Ecological Knowledge (TEK).

Assessments contain the baseline data that can be used in regional and global assessments. They are the fully referenced and independently reviewed collaborative efforts of hundreds of scientific and TEK experts from across the circumpolar region.

These strategies are developed via intensive international cooperation between countries and scientists across the Arctic region.

CAFF Strategies

To help fulfill its mandate, CAFF produces a range of strategies that provide scientific and conservation recommendations on how to implement plans intended to directly conserve species and ecosystems. Strategies develop a framework to ensure the most effective management response.

Expert Groups

CAFF may establish expert groups with specific mandates related to key activities.

These expert groups ensure that scientists, conservationists, and managers have a forum to promote, facilitate, and coordinate conservation, management, and research activities of mutual concern. These groups have been invaluable in synthesising, coordinating and publishing research.

These groups are:

- CAFF Flora Group (CFG)
- Circumpolar Seabird Group (CBird)
- Circumpolar Protected Areas Network (CPAN)
- Marine (CBMP)
- Freshwater (CBMP)
- Terrestrial (CBMP)
- Coastal (CBMP)

Resource information:

www.caff.is

POLICY

CAFF is one of the Arctic's leading organizations that provides Key Findings, Policy recommendations and Advice on bodiversity to Arctic policy makers. It was established in 1991 after Canada, Denmark, Finland, Iceland, Norway, Sweden, the USSR and the United States adopted the Arctic Environmental Protection Strategy (AEPS), a multilaterial agreement among Arctic states to protect the Arctic environment. During the development of the AEPS, the eight Arctic countries confirmed that their shared ecosystem, with its unique flora and fauna, was fragile and threatened by a number of causes. They agreed to "*cooperate for the conservation of Arctic flora and fauna, their diversity and their habitats*" and, to that end, established the Program for the Conservation of Arctic Flora and Fauna (CAFF) as a "*distinct forum for scientists, indigenous peoples and conservation managers ...to exchange data and information on issues such as shared species and habitats and to collaborate, as appropriate for more effective research, sustainable utilization and conservation*".

In 1996 the Ottawa Declaration formally established the Arctic Council as a high level intergovernmental forum to provide a means for promoting cooperation, coordination and interaction among the Arctic States, with the involvement of the Arctic Indigenous communities and other Arctic inhabitants on common Arctic issues. The Arctic Council now oversees and coordinates the programs established under the AEPS including CAFF, the Arctic Monitoring and Assessment Program (AMAP), the Protection of the Arctic Marine Environment (PAME) and the Emergency Prevention Prepardness and Response (EPPR) working groups.

Over the subsequent two decades CAFF has become an important forum for the discussion and development of strategies, assessments, monitoring and recommendations that feed into the Arctic Council process to increase knowledge, address knowledge gaps and contribute to the knowledge necessary to inform policy.

GEO

GEO is a unique global network connecting government institutions, academic and research institutions, data providers, businesses, engineers, scientists and experts to create innovative solutions to global challenges at a time of exponential data growth, human development and climate change that transcend national and disciplinary boundaries. The unprecedented global collaboration of experts helps identify gaps and reduce duplication in the areas of sustainable development and sound environmental management.

Together, the GEO community is creating a Global Earth Observation System of Systems (GEOSS) to better integrate observing systems and share data by connecting existing infrastructures using common standards. There are more than 400 million open data resources in GEOSS from more than 150 national and regional providers such as NASA and ESA; international organizations such as WMO and the commercial sector such as Digital Globe.

The GEO Work Programme 2023-2025

The GEO Work Programme is the primary instrument used by GEO to facilitate collaboration among its Members, Participating Organizations, GEO Associates, and other partners on activities to realize GEO's Mission and Vision.

The activities that comprise the GEO Work Programme are conceived, planned and implemented by teams of researchers, technical experts, policy analysts, commercial sector representatives, and many other stakeholders to address information needs in particular domains for which Earth observations are critical. In most of these activities, the teams work to develop Earth observation-based applications, products and services to support decisions by defined sets of users.

GEO Work Programme activities are largely funded through in-kind contributions from GEO Members, Participating Organizations and Associates on a voluntary, best-efforts basis, supplemented by financial contributions where possible. A small number of activities, the GEO Foundational Tasks, are implemented in part by the GEO Secretariat through resources contributed by GEO Members to the GEO Trust Fund.

Each GEO Work Programme covers a fixed three-year period. The GEO Work Programme 2023-the GEO-18 Plenary in Ghana recently approved 2025 on 3 November 2022.

Implementation Plans

GEO Flagships

GEO Biodiversity Observation Network
GEO Global Agricultural Monitoring
GEO Land Degradation Neutrality
Global Forest Observation Initiative
Global Observation System for Mercury

GEO Initiatives

AquaWatch
Data Integration and Analysis System
Digital Earth Africa
Earth Observations for Disaster Risk Management
Earth Observations for Ecosystem Accounting
GEO Blue Planet
GEO Capacity Building in North Africa, Middle East, Balkans and Black Sea Region
GEO Global Water Sustainability
GEO Human Planet
Global Network for Observations and Information in Mountain Environments
Global Observation System for Persistent Organic Pollutants
Global Urban Observation and Information
Global Wildfire Information System

GEO Pilot Initiatives

Antarctic Ice Sheet Monitoring
Arctic GEOSS
Digital Earth Pacific
Earth Observations for Global Typical Karst
Earth Observations for multi-scale monitoring of mining impacts
Earth Observations for the Water-Energy-Food Nexus
GEO Essential Variables
Geodesy for the Sendai Framework
Open Earth Alliance
Space and Security
Urban Heritage Climate Observatory

Regional GEOs

African Group on Earth Observations
Americas Group on Earth Observations
Asia-Oceania Group on Earth Observations
European Group on Earth Observations

Resource information:
www.earthobservations.org/index.php

IASC

IASC is engaged in all fields of Arctic research and its main scientific working bodies are five Working Groups: Atmosphere, Cryosphere, Marine, Social & Human and Terrestrial. Each Working Group is composed of up to two scientists from each IASC member country, appointed by the national adhering bodies. Though the Working Groups are disciplinary, they also address crosscutting science questions by initiating activities, which involve at least two WGs.

IASC's instruments to support science development include workshops, long-term programs, assessments and science planning activities.

CURRENT ARCTIC RESEARCH PRIORITIES

The Role of the Arctic in the Global System

- Improving understanding of connections between Arctic changes and mid-latitude & tropical weather, weather extremes, climate variability, and environmental processes.
- Observing, understanding, and forecasting Arctic (environmental) change.
- Improving understanding of Arctic amplification and Arctic climate feedbacks.
- Developing new approaches to monitoring changes in energy, water, and carbon budgets in the Arctic region.
- Evaluating the contributions of Arctic ice sheets and glaciers to regional and global sea level change.
- Studying past environmental changes through climate.
- Tracking the identification and consumption of resources.

Observing and Predicting Future Climate Dynamics and Ecosystem Responses

- Observing, understanding, and forecasting Arctic (environmental) change – especially using improved coupled numerical models and Earth system models.
- Sustaining and developing long-term data sets, including paleolimnological and paleo-oceanographical approaches to validate Arctic predictive models.
- Monitoring greenhouse gases, trace gases and aerosols in the Arctic, with the aim to improve understanding of aerosol-cloud interactions, climate feedbacks, and the Arctic amplification.
- Investigating interactions and coupling processes at climate domain interfaces to improve understanding of Arctic amplification and Arctic climate feedbacks and improve regional climate models.
- Monitoring long-distance pollution transport to the Arctic (aerosols, trace gases, inorganic and persistent organic pollutants, radionuclides), and how this may respond to emission, deposition, and climate changes.
- Monitoring heat and energy transport in the atmosphere and ocean into and out of the Arctic (warm air intrusions, cold air outbreaks, variability of Atlantic and Pacific water in- and outflow, sea ice and ocean freshwater export).
- Developing new observing systems and capabilities, including improving coordination with spaceborne Earth Observation programs (see the New & Novel section).
- Monitoring future developments in the Central Arctic Ocean, including sea ice cover, commercial fishing potential and transportation routes, and exploitation of natural resources.
- Charting the greening & browning of the Arctic (large-scale, as well as microhabitats).
- Investigating life in (extreme) Arctic environments – disappearing ecosystems, resurrected ecosystems, adaptation strategies of populations and invasive species.
- Analyzing the changing Arctic Critical Zone in the framework of geosphere-biosphere interactions and permafrost thaw.

Understanding the Vulnerability and Resilience of Arctic Environments and Societies and Supporting Sustainable Development

- Better integrating Indigenous, Traditional, and Local Knowledge in research efforts and co-design/co-produce Arctic research strategies and projects with northern and Indigenous communities.
- Monitoring contaminants and pollutants (including plastics and pathogen pollutants) in all parts of the Arctic environment and understanding their sources from and impacts on Arctic societies.
- Improving understanding of the Arctic water cycle and its response to climate change.
- Understanding natural hazards and extreme weather (associated with climate change).
- Investigating the intersection of environmental sustainability, maritime technology, and shipping safety.
- Investigating the nexus of climate change, resilience, and adaptation in the context of Arctic environmental change.
- Promoting health and wellness – community vitality, adapting to a new Arctic, introduced species, including pathogens, vectors, and parasites, and holistic human-environment approaches.
- Fostering diversity, gender equality, and inclusion in Arctic research Researching both Arctic history and archaeology.
- Documenting coastal erosion and the impacts on carbon cycling, infrastructure, communities, ecosystems, and improve risk assessments for both the socio-economic system and ecosystems (e.g. floods, mass movements in land and solution of water resources).

Resource information:

www.iasc.info

MAJOR ONGOING & UPCOMING PROJECTS

International coordination is key for building public engagement, knowledge-sharing and impactful initiatives.

Examples of collaborative projects currently ongoing or upcoming in the Arctic research community include, but are not limited to:

- ACRoBEAR (Arctic Community Resilience to Boreal Environmental change: Assessing Risks from fire and disease).
- ALPACA (Alaskan Layered Pollution And Chemical Analysis).
- The Arctic Five: a university alliance of 5 universities in Norway, Sweden and Finland.
- Arctic PASSION: is an EU Horizon 2020 project.
- ARTofMELT (Atmospheric rivers and the onset of sea ice melt).
- CHARTER (Drivers and Feedbacks of Changes in Arctic Terrestrial Biodiversity).
- CRiceS (Climate Relevant interactions and feedbacks: the key role of sea ice and Snow in the polar and global climate system).
- EU Polar Cluster: is a network of EU Horizon 2020 and a Framework Program 7 funded Arctic, Antarctic / Southern Ocean and Polar projects.
- EU-PolarNet 2: is the world's largest consortium of expertise and infrastructure for polar research.
- European Space Agency (ESA) Polar Science Cluster: joins several ESA-funded projects and activities.
- FACE-IT is an EU Horizon 2020.
- INTERACT (the International Network for Terrestrial Research and Monitoring in the Arctic).
- International Tundra Experiment (TEX) studies effects of warming on vegetation and soil.
- JUSTNORTH is an EU Horizon 2020 project that investigates different dimensions of ethical systems and justice in the economic development in the Arctic.
- MOSAiC (Multidisciplinary drifting Observatory for the Study of Arctic Climate).
- The Nansen Legacy: works towards a holistic understanding of the changing climate and ecosystem of the northern Barents Sea and adjacent Arctic Ocean.
- Navigating the New Arctic (NNA): is an US NSF-funded project that tackles convergent scientific challenges in the rapidly changing Arctic.
- Nunataryuk: is an EU Horizon 2020 funded project studying coastal catchments in permafrost areas, coastal erosion and impacts on carbon cycling, and science for socioeconomic adaptation.
- PolarRES (Polar Regions in the Earth System): is a EU Horizon 2020 project.
- Polar to Global Online Interoperability and Data Sharing Workshop.
- SIOS (Svalbard Integrated Arctic Observing System).
- Synoptic Arctic Survey (SAS) and Distributed Biological Observatory (DBO).
- T-MOSAiC (Terrestrial Multidisciplinary Distributed Observatories for the Study of Arctic Connections).
- Truth and Reconciliation in the Nordic Countries (TRiNC).
- Year of Polar Prediction (YOPP).

IASSA

IASSA, established in 1990, is the professional association of social sciences and humanities scholars that includes more than 700 members encompassing disciplines relating to behavioral, psychological, cultural, anthropological, archaeological, linguistic, historical, social, legal, economic, environmental, and political subjects, as well as health, education, the arts and humanities, and related subjects.

IASSA is an observer to the Arctic Council and contributes to its work through the involvement of its representatives and members in the wide scope of the Arctic Council activities.

ACTIVITIES

The IASSA objectives and research and policy goals are:

- to promote and stimulate international cooperation and to increase the participation of social scientists in national and international Arctic research
- to expand the role of social sciences and humanities in Arctic research and policy, including the Arctic Council
- to promote the active collection, exchange, dissemination, and archiving of scientific information in the Arctic social sciences
- to support Indigenous scholars, organizations and residents, facilitate Indigenous knowledge (IK) and knowledge co-production
- to facilitate culturally, developmentally, and linguistically appropriate education in the North
- to follow the IASSA statement of ethical principles for the conduct of research in the Arctic
- to support the implementation of the Agreement on Enhancing International Arctic Scientific Cooperation signed by the Arctic Council members in 2017

PROJECTS AND INITIATIVES

10th International Congress of Arctic Social Sciences (Arkhangelsk, Russia, June 15-19, 2021) Developing network and knowledge sharing opportunities through supporting research coordination networks: Arctic-FROST, Arctic-COAST, Percs-Net, US NAF NNA programs, Horizon 2020 research and planning activities, national and international research plans, including initial preparations for ICARP IV.

Support Arctic Council activities by supplying expertise in various projects and initiatives, including ECONOR, Gender Equality in the Arctic, Arctic Human Development Report, Arctic Resilience Forum, as well as language, wellbeing and Indigenous Knowledge-focused projects.

Resource information:
www.iassa.org

ICES

THE INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA (ICES) is an intergovernmental marine science organization, meeting societal needs for impartial evidence on the state and sustainable use of our seas and oceans.

Our goal is to advance and share scientific understanding of marine ecosystems and the services they provide and to use this knowledge to generate state-of-the-art advice for meeting conservation, management, and sustainability goals.

We are a network of nearly 6000 scientists from over 700 marine institutes in our 20 member countries and beyond. Over 2500 scientists participate in our activities annually.

Through strategic partnerships our work in the Atlantic Ocean also extends into the Arctic, the Mediterranean Sea, the Black Sea, and the North Pacific Ocean.

GLOBAL COOPERATION

We work together with other scientific organizations on topics of mutual interest.

This cooperation takes the form of joint working groups, co-sponsored theme sessions at annual science meetings, and co-sponsored science symposia.

A strategic planning framework has been established specifically for the cooperation with the North Pacific Marine Science Organization (PICES), our sister organization in the North Pacific.

Science cooperation agreements are also in place with more than 20 global and regional organizations including:

- UN Intergovernmental Oceanographic Commission (IOC)
- Food and Agriculture Organization (FAO)
- Arctic Monitoring and Assessment Programme (AMAP)
- International Arctic Science Committee (IASC)
- BONUS programme (science for a better future of the Baltic Sea region)
- General Fisheries Commission in the Mediterranean (GFCM)
- Mediterranean Science Commission (CIESM)

We hold an official observer status to the United Nations General Assembly, the Arctic Council, and the SeaDataNet.

In addition, we have contracts and agreements with public authorities and commissions we provide advice for, including:

- European Commission (EC)
- Helsinki Commission (HELCOM)
- North Atlantic Salmon Commission (NASCO)
- North East Atlantic Fisheries Commission (NEAFC)
- OSPAR Commission (OSPAR).

PROJECTS

We contribute to the developments in marine science through our external project work and collaborate with a variety of organizations to achieve this.

ICES involvement in external projects is decided based on our project policy and consultation with our Executive Committee (Bureau). For more information, see our project policy.

BY PARTICIPATING IN PROJECTS, we:

- provide scientific support for implementation of the Marine Strategy Framework Directive (MSFD)
- support development of the European Integrated Maritime Policy by developing interactions between partners (the research community, industry, regional authorities, civil society and other stakeholders) and delivering data/information to policy-makers
- develop fisheries management plans for the Natura 2000 sites (Marine Protected Areas)
- manage datasets
- underpin cooperation between marine research funding agencies

CURRENT PROJECTS in which we are involved:

1. All Ocean Obs
2. Baltic Data Flows
3. B-USEFUL
4. EMODnet Biology
5. EMODnet Chemistry
6. EMODnet Data Ingestion
7. EMODnet Physics
8. MEESO
9. Mission Atlantic
10. PANDORA
11. QUIETSEAS
12. SEAwise

Resource information:

www.ices.dk

ICES/PICES

The North Pacific Marine Science Organization (PICES), an intergovernmental science organization, was established in 1992 to promote and coordinate marine research in the North Pacific and its adjacent seas. Its present members are Canada, Japan, People's Republic of China, Republic of Korea, the Russian Federation, and the United States of America.

PROGRAM IN PROGRESS

FUTURE (Forecasting and Understanding Trends, Uncertainty and Responses of North Pacific Marine Ecosystems) is an integrative Scientific Program undertaken by the member nations and affiliates of PICES to understand how marine ecosystems in the North Pacific respond to climate change and human activities, to forecast ecosystem status based on a contemporary understanding of how nature functions, and to communicate new insights to its members, governments, stakeholders and the public (October 2009 - Present).

PROJECTS IN PROGRESS

1. Ciguatera Building Local Warning Networks for the Detection and Human Dimension of Ciguatera Fish Poisoning in Indonesian Communities (April 2020 – March 2023)

The overall goal of the project is to build the capacity of local small-scale fishers and community members to monitor their coastal ecosystems and coastal fisheries. The project's focus is to detect and monitor *Ciguatera Fish Poisoning* (CFP) in tropical reef fisheries, which globally has the most significant human health and economic impacts of any algal-based poisoning syndromes. Creating community empowerment will benefit human health in Pacific Rim developing countries. As well, the project will generate transferable knowledge for ocean communities with similar climate or environmental stresses.

The project strategy will comprise an "*Assess. Detect. Avoid!*" convention to protect communities against this emerging health concern:

- To *Assess* the state of the local coral reefs, a common ecosystem for ciguatoxic fish, community members will monitor some aspects of water quality (turbidity and water color) of the reef, and document the outbreaks of eel-grass or the expansion of the dead coral (all factors associated with increased CFP presence) using the smartphone-based tools and approach developed during the FishGIS project.
- To *Detect* the presence of the toxin-containing dinoflagellates in the reef environment, two approaches will be used: one that is developed within the project and is based on specialized smartphone-driven microscopes (Foldscopes) and community-appropriate protocols, and the other that employs a detection kit recently created by an international CFP working group (International Atomic Energy Agency (IAEA); see also FAO and WHO (2020)) to determine the presence of Gambierdiscus and Fukuyoa in the water column and measure their abundance. These two technologies will meld well to help develop predictive indices for reef regions susceptible to CFP.
- To *Avoid* the transfer of contaminated fish from the damaged environment to the tables of families, the community will be trained to reduce risk – avoid eating fish from regions where Gambierdiscus and Fukuyoa numbers are high. This simple message will require an investment in socio-ecological scientists – a specialty of the MAFF mandate.

2. SEAturtle Sea turtle ecology in relation to environmental stressors in the North Pacific region (December 2018 - November 2022).

The overall project goal is to research the sea turtle population found in the North Pacific regions centering on Jeju Island of Korea to enhance the understanding of their habitat use and ecology related to anthropogenic activities. The project key questions are: (a) How the sea turtles found in Jeju Island, Korea, Kyushu Island, Japan, and Hong Kong, China are connected to the other identified populations in the North Pacific areas and (b) What are the major environmental stressors to the sea turtles in the North Pacific regions.

3. PICES Metadata Federation

4. CPR Survey

5. NPESR - North Pacific Ecosystem Status Report (2010)

The PICES report on marine ecosystems is intended to periodically review and summarize the status and trends of the marine ecosystems in the North Pacific, and to consider the factors that are causing or are expected to cause change in the near future.

Resource information:

www.meetings.pices.int

INTERACT

INTERACT is an infrastructure project under the auspices of SCANNET, an arctic network of 68 terrestrial field bases (formerly 89, but collaboration with Russia is currently on hold) in northern Europe, US, Canada, Greenland, Iceland, the Faroe Islands and Scotland as well as stations in northern alpine areas. INTERACT specifically seeks to build capacity for research and monitoring all over the Arctic, and is offering access to numerous research stations through the Transnational Access Program.

ARCTIC ACTIVITIES

INTERACT has an annual call for its transnational access program. The next call will be out in September with a deadline in October 2020 for next summer's field season. In addition to the physical access when scientists actually go to the research stations, also another modality is especially useful during the current COVID-19 pandemic, which is remote access. It basically means that the staff at the research stations are taking samples for the scientists and send them back to the scientists.

MAJOR ACTIVITIES

INTERACT provides access to 53 research stations in all Arctic countries for scientists from all over the world through its transnational access program.

At present, INTERACT has sent more than 1000 scientists to do field work in the Arctic. INTERACT also ensures best practices at the research stations e.g. by decreasing the impact on local environment and by training visitors in field safety through its Station Managers' Forum. INTERACT's Data Forum are enhancing data availability from the research stations and is guiding stations in data management to ensure that the FAIR principle is being used. INTERACT produces educational and outreach material for everything from elementary school kids to University students to the public.

Finally, INTERACT works with industry and companies, local and indigenous communities and policy advisors on societal challenges in the Arctic with global impacts such as extreme weather events, increased tourism, transport and communication, pollution.

Resource information:
www.eu-interact.org

PEI

Polar Educators International (PEI) is an essential network of educators and researchers aiming to provide a deeper understanding of current polar sciences to a global audience.

MISSION

Connecting polar education, research, and the global community.

By leading dialogue and collaboration between educators, and researchers, PEI aims to highlight and share the global relevance of the polar regions.

VISION

PEI represents all who work to inspire appreciation and build knowledge of the polar regions, their connectedness to all Earth's systems, and their importance to all humans across latitudes and cultures. A PEI member is anyone who is interested in making the poles accessible, promoting understanding and stewardship of the polar regions, and seeking to grow polar literacy by communicating polar science to the world.

GOALS

- COMMUNICATE: Develop a robust, flexible, and trusted international presence
- COLLABORATE: Grow and strengthen the PEI network and its relationships
- CREATE: Provide relevant and timely opportunities for both education and scientific communities

Polar Educators International's core strengths of communication, collaboration, & creation are how we connect the qualities of scientific and educational organizations, defining our unique position, which allows us to provide a deeper understanding of current polar sciences to a global audience.

CORE VALUES

- CREDIBLE: Experience and knowledge build a robust scientific foundation which can be trusted by our audiences and partners
- WELCOMING: Diverse backgrounds and perspectives encouraging an accessible and empowered community agreeing to grow together
- PASSIONATE: A shared belief in the power of education motivates our drive to communicate the importance of the polar regions
- DEDICATED: Commitment to effective advocacy drives our efforts and resources for polar knowledge and action

STRATEGIC PLAN

The Strategic Plan was drafted by a working group in late 2019 and was later approved by the Council and Executive Committee. The Plan outlines PEI's short and long-term (5-year) goals but is an ever-evolving document reflecting the goals. It is intended to grow and change along with the organization.

- Goal #1 - Communicate: To develop a robust, flexible, & trusted international presence

Long-term Outcome #1: PEI's digital education and communication tools are evaluated and updated regularly to ensure usefulness to the network.

Long-term Outcome #2: *Active membership grows, sustaining the PEI network.*

- Goal #2 - Collaborate: To grow and strengthen the PEI network and its relationships

Long-term Outcome #1: *Secure sustainable funding to participate in relevant professional meetings as the representative for polar education.*

Long-term Outcome #2: *Potential partners recognize the value in a PEI partnership and begin to invite PEI to initiate partnership processes and build capacity.*

Long-term Outcome #3: *PEI members, partners and global community utilize and contribute to PEI resources.*

- Goal #3 - Create: To provide relevant & timely opportunities for education & scientific communities

Long-term Outcome #1: *Effective local and international networks are developed and sustainable.*

Long-term Outcome #2: *Education opportunities provided within our network are current and sustainable.*

Long-term Outcome #3: *Build accessible resources for polar education.*

Resource information:
www.polareducator.org

SAON collaborates closely with its partners and other prominent Arctic and international organisations as well as with the Arctic Council Permanent Participants to find synergies and joint activities to avoid overlapping efforts. The collaboration includes, but is not limited to:

- Arctic Monitoring and Assessment Programme (AMAP)
- Arctic Challenge for Sustainability Project (ArCS II)
- Arctic Portal
- Conservation of Arctic Flora and Fauna and The Circumpolar Biodiversity Monitoring Programme (CAFF/CBMP)
- EU-PolarNet
- EuroGOOS
- European Union (EU) (European Commission (EC)
- European Polar Board (EPB)
- European Space Agency (ESA)
- Group on Earth Observations (GEO) and GEO Cold Regions Initiative (GEOCRI)
- International Arctic Systems for Observing the Atmosphere (IASOA)
- International Study of Arctic Change (ISAC)
- Inuit Circumpolar Council (ICC)
- Integrated Arctic Observation System (INTAROS)
- International Council for the Exploration of the Sea (ICES)
- International Network for Terrestrial Research and Monitoring in the Arctic (INTERACT)
- Pacific Arctic Group (PAG)
- Polar Research Institute of China (PRIC)
- PolarView
- Saami Council (SC)
- Svalbard Integrated Arctic Earth Observing System (SIOS)
- US Arctic Observing Network (US AON)
- University of the Arctic (UArctic)
- World Meteorological Organization (WMO)

The Arctic Data Committee (ADC) currently has these activities:

1. Mapping the Arctic Data Ecosystem

(Lead: Peter Pulsifer, USA):

This activity has a focus on the expansion of content, improvement of the display, database and query technology, and significant promotion of the results. WP activities will be done in collaboration with a complementary EU-PolarNet project. More information: http://arcticdc.org/products/data-ecosystem-map and http://arcticdc.org/products/partner-data-products.

2. Common Metadata Elements

(Lead: Julie Fridell, Canada):

This activity will refine a previously developed inventory of different metadata profiles being used in polar science. Additional work and resources are required and a Canadian funding initiative may provide some support for this effort if successful.

3. Data Publication and Citation

(Lead: Alex Tate, UK)

A summary web page has been created containing references to a selection of key documents and best practices relevant to data publication and citation.

More information: http://arcticdc.org/activities/core-projects/data-publication

4. Network Building

Network building and in particular building connections with external bodies focused on various aspects of data management, sharing and use is a priority. More information: http://arcticdc.org

5. Response to OGC RFI Arctic Spatial Data Pilot

The Committe has responded to a Request for Information from the Open Geospartial Consortium on an Arctic spatial data pilot project and the response is well reflected in the final report from the Consortium.

6. Engagement with GEO & GEO Cold Region Initiative (GEOCRI) (with CON)

ADC and CON has provided input to the GEOCRI implementation plan.

Resource information:

www.arcticobserving.org

info@arcticobserving.org

SDWG

Sustainable Development Working Group

The SDWG strives to be a leading force for sustainable development in the Arctic. Through its regional leadership, it contributes to global sustainable development efforts such as the UN Agenda 2030 Sustainable Development Goals (SDG) and to climate change mitigation and adaptation efforts such as the Paris Agreement under the UN Framework Convention on Climate Change (2015). The adoption of Agenda 2030 in particular provides new momentum to enhance sustainable development activities relevant to the Arctic and resonates with the past, present and future work of the SDWG.

The SDWG, through the lens of the human dimension, will encourage projects and initiatives that strengthen the resilience and well-being of the peoples of the Arctic and promote the three basic sustainable development pillars (social equity, economic development and environmental protection).

The SDWG will encourage culturally appropriate projects and activities (both independent and cross-cutting with other Arctic Council subsidiary bodies) in the following areas (listed alphabetically):

- Community vitality: increase foundational knowledge of human development and the indicators of community vitality and provide tools for constructive solutions to demographic challenges, patterns of human settlement, urban planning and mobility. Promote the linkages between the protection of the environment and wellness, resilience and adaptability of communities.
- Economic assessments: strengthen analysis and joint monitoring of economic trends and activities in the Arctic, to include both cash and subsistence economies, to enhance sustainable and diverse economic development, investments and policies.
- Educational opportunities: develop circumpolar networks and harness innovative technologies to build knowledge and develop skills needed to maintain vibrant communities in a changing region.
- Heritage and culture of Arctic communities: deepen global understanding of the region's peoples, cultures, traditional ways of life, languages and values and promote traditional and local knowledge.

Sustain and celebrate Indigenous languages, traditional lifeways and practices, including knowledge about traditional diets and food security. Support the identification and promotion of heritage sites and areas of particular cultural significance in the Arctic.

- Human health: exchange information, assessments and innovations that can support public health systems and health service delivery (including clean energy sources/systems) - with particular emphasis on projects that reduce death and disability from environmental risk factors, suicide, and high-burden infectious and chronic diseases.
- Infrastructure: provide information to inform responsible and sustainable long-term investments in all forms of Arctic infrastructure while taking into account the present needs of communities as well as the changing environment through independent efforts and in coordination with other subsidiary bodies and task forces.

- **Reduction/elimination of inequalities:** strengthen and promote the adoption of sound policies for the elimination of inequalities based on age, sex, disability, race, ethnicity, origin, religion or economic or other status at all levels.
- **Science and research for sustainable development:** facilitate good use of the Arctic region's research institutions and extensive intellectual resources to benefit sustainable development, including through academic exchanges and joint Arctic research.
- **Sustainable business involvement and development:** explore economic development, including in new and emerging sectors, and evaluate its potential benefits, including job creation and promotion of local culture and products. Highlight the sustainable development impacts of such sectors, create new frameworks and provide necessary support to all stakeholders in addressing the challenges and opportunities resulting from a larger and more diversified business presence in the region.
- **Sustainable energy:** promote responsible and sustainable management, use and development of energy and resources as well as innovative approaches encouraging renewable energy in even the most remote Arctic communities.

- **Transportation links:** promote the development of sustainable transportation infrastructure and traditional corridors that increase the capabilities for efficient movement of people and goods that have implications for Arctic communities, often in cooperation with other subsidiary bodies as mentioned below.

- **Water and sanitation services:** strengthen the participation of local communities in improving sustainable water, sanitation and waste disposal management with an eye to the unique engineering challenges and environmental risks that the region faces.

In addition, the SDWG will encourage collaboration with other Arctic Council working groups and subsidiary bodies by contributing to the human dimension of projects and initiatives that focus on, but are not limited to, the following:

1. **Climate change:** support cooperative circumpolar efforts in building community resilience and adaptive capacity.

2. **Protection and sustainable use of the Arctic marine environment:** address the sustainable development impacts of emerging Arctic shipping routes, promotion of traditional marine transportation, support of Indigenous marine management in the Arctic, water and ocean safety and human interaction with the global water cycle.

3. **Arctic environmental monitoring and assessments:** generate, promote and share of knowledge and data aimed at increased awareness of environmental and natural processes and prevention of natural and anthropogenic disasters.

4. **Protection of Arctic flora and fauna:** address the sustainable use and preservation of Arctic ecosystems and their role in human well-being and social and economic development, and the integration of traditional ecosystem and biodiversity values into national and local planning and development processes.

Resource information:
www.sdwg.org
secretariat@sdwg.org

UARCTIC

UArctic

The University of the Arctic (UArctic) is a network of universities, colleges, research institutes, and other organizations concerned with education and research in and about the North.

UArctic builds and strengthens collective resources and infrastructures that enable member institutions to better serve their constituents and their regions.

Through cooperation in education, research, and outreach we enhance human capacity in the North, promote viable communities and sustainable economies, and forge global partnerships. Created through the Arctic Council, UArctic is committed to upholding its principles of sustainable development as well as the United Nations Sustainable Development Goals. UArctic is constituted as an international association based in Finland.

UArctic promotes northern research, innovation, knowledge generation, and traditional knowledge through collaboration between its members.

The cryosphere UArctic is a network of more than 200 members engaged in collaborative education (e.g., circumpolar research), research, and outreach activities.

These include both face-to-face and online-courses at all levels, the North2North mobility program, collaborative research, and other project activities. Most of these activities take place in more than 50 thematic networks that focus on current Arctic topics. These thematic networks include partners from across the Arctic and beyond and often work in cooperation with other Arctic organizations.

Resource information:
www.uarctic.org

THE UNITED NATIONS ENVIRONMENT PROGRAMME

Since its inception in 1972, THE UNITED NATIONS ENVIRONMENT PROGRAMME (UNEP) has been the global authority that sets the environmental agenda, promotes the coherent implementation of the environmental dimension of sustainable development within the UN system and serves as an authoritative advocate for the global environment.

UNEP's mission is to provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations.

UNEP works on delivering transformational change for people and nature by drilling down on the root causes of the three planetary crises of climate change, nature and biodiversity loss, and pollution and waste. UNEP employs seven interlinked subprograms for action: Climate Action, Chemicals and Pollutions Action, Nature Action, Science Policy, Environmental Governance, Finance and Economic Transformations and Digital Transformations.

Through its campaigns, particularly World Environment Day, UNEP raises awareness and advocates for effective environmental action.

Headquartered in Nairobi, Kenya, UNEP works through its divisions as well as regional, liaison and out-posted offices and a growing network of collaborating centers of excellence.

UNEP works closely with its 193 Member States and representatives from civil society, businesses, and other major groups and stakeholders to address environmental challenges through the UN Environment Assembly, the world's highest-level decision-making body on the environment.

The organization hosts the secretariats of many critical multilateral environmental agreements and research bodies.

The Executive Director and Senior Management Team lead the implementation of UNEP's Medium-Term Strategy (MTS). The four-year MTS articulates UNEP's role in delivering the promises of the 2030 Agenda for Sustainable Development and the UN Conference on Sustainable Development (Rio+20) as well as its outcome document, "The Future We Want."

UNEP supports Member States to ensure that environmental sustainability is reflected in development and investment planning and provides countries with the necessary tools and technologies to protect and restore the environment.

To deliver on its programme, UNEP's relies on voluntary financial contributions to the programme budget. Ninety-five per cent of this funding is provided voluntarily by funding partners.

Resource information:
www.unenvironment.org
unepinfo@unep.org

UNEP

UN environment WCMC

WMO

WORLD METEOROLOGICAL ORGANIZATION

WORLD METEOROLOGICAL ORGANIZATION (WMO)

As weather, climate and the water cycle know no national boundaries, international cooperation at a global scale is essential to implement an Earth system approach for the development of meteorology, climatology, operational hydrology and related environmental services as well as to reap the benefits from their application. WMO provides the framework for such international cooperation.

As a specialized agency of the United Nations, WMO is dedicated to international cooperation and coordination on the state and behavior of the Earth's atmosphere, its interaction with the land and oceans, the weather and climate it produces, and the resulting distribution of water resources.

CURRENT PROJECTS

Establish Climate Services for the Arctic Polar Region

Implementing the GFCS at Regional and National Scales. The cryosphere – frozen precipitation, snow cover, sea ice, lake and river ice, glaciers, ice caps, ice sheets, permafrost and seasonally frozen ground – is a critically important component of the Arctic Climate System. Global climate, water and weather as well as other environmental areas are also highly influenced by the cryosphere. It is a major indicator of global climate change and plays a fundamental role in Earth's climate system. The WMO Global Cryosphere Watch (GCW), initiated in 2011, provides authoritative information on present, future and past states of the world's snow and ice resources.

The cryosphere is the key to providing climate services in the Arctic region where climate prediction skills are currently severely limited and require substantial additional research. Existing climate products and services – sea-ice monitoring, satellite observations of ice extent and specialized predictions – have to be operationalized and brought to proper application. A cohesive and integrated effort to observe, monitor, assess and predict the state of the cryosphere is needed. In addition, this effort has to be underpinned by coherent and coordinated research and product development. The Global Cryosphere Watch must gain an understanding of users' needs for climate information in the Arctic Region in order to address them. Activities will also have to be coordinated at regional, national and local levels to cover the requirements of northern communities and indigenous peoples.

In this project WMO facilitates effective interactions between experts on climate modelling from the circumpolar regions, the Intergovernmental Panel on Climate Change (IPCC), the Arctic Climate Impact Assessment (ACIA), and providers of land, satellite and marine observations, climate services, climate risk management, user communities and other stakeholders with the goal to promote research and capacity development towards effective climate services for the polar region.

This project is part of the programme for Implementing the Global Framework for Climate Services at Regional and National Scales

Polar Prediction

Concerns about amplification of anthropogenic climate change has led to a growing interest in the polar regions in recent years. Furthermore, increasing economic and transportation activities in Polar regions are leading to more demand for sustained and improved availability of integrated observational and predictive weather, climate and water information to support decision-making. However, many gaps in weather, subseasonal and seasonal forecasting in Polar regions hamper reliable decision-making.

The World Weather Research Programme's Polar Prediction Project aims to advance the science in numerical models, data acquisition and assimilation; ensemble forecast methods, verification, and the production of prediction products – all with a polar emphasis. Observations are a key element in this endeavor. The Polar regions are among the most sparsely observed parts of the globe by conventional observing systems such as surface meteorological stations, radiosonde stations and aircraft reports.

Resource information:
www.public.wmo.int/en
wmo@wmo.int

Photographer: Alexey Zhirukhin
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Photographer: Vasily Iakovlev
Russia

ASM4 WEBINAR SERIES

ASM4 WEBINAR SERIES

As part of its chairmanship of the Arctic Council, Russia has fulfilled its obligations. It continues to work to preserve environmental safety in the region, prevent marine pollution and industrial emissions, and support international cooperation in Arctic research. Russia also continues to contribute to the sustainable development of the Arctic regions, including creating new economic opportunities and improving the quality of life of the local population. Overall, great importance is attached to the preservation of the unique Arctic environment and cooperation with all interested countries on this important issue.

Russia coordinated the activities of the Ministerial Meeting on Science Development in the Arctic (ASM), and the Russian State Hydrometeorological University was designated as responsible for these activities.

Thus, to improve the quality of interaction between scientists, specialists, and indigenous peoples of the North and stakeholders involved in Arctic studies under ASM4, a series of webinars on priority topics was developed:

1. Current and Promising Forms of Scientific Cooperation in the Arctic.
2. Linking Past and Present Marine Ecosystems. Exploring the Marine Environment.
3. Conserving Biodiversity of Ecosystems in the Arctic Zone.
4. Indigenous Peoples and the Environment.
5. Mastering the Arctic by Gaining Knowledge. Accessibility of Education in the Arctic.
6. Monitoring and Research on Climate Change in the Arctic Region. Assessing the challenges of Arctic pollution and climate change.

The ASM4 website:
www.asm4.ru
www.rshu.ru

1. Current and Promising Forms of Scientific Cooperation in the Arctic

This was an introductory webinar designed to provide an overview of general issues of scientific cooperation in the Arctic region, as well as an introduction to the upcoming webinars in the series.

The webinar was open to the public - everyone interested in the topic was able to participate. Therefore, the possibility of popularizing the Arctic region and promoting the idea of the Arctic as a place for cooperation and life was planned.

The webinar looked at capacity building in science and education for Arctic residents, including indigenous communities, and recognized the importance of putting knowledge into practice within the education system. Adapting education systems to incorporate traditional and local knowledge is necessary for Arctic residents to become more resilient to environmental change.

The establishment of an ASM4 research database to serve as an information resource for organizations and agencies involved in economic activities in the Arctic was also considered to strengthen scientific and educational cooperation with the countries of the Arctic region.

It was noted that we are also in favor of developing forms of "open science," common platforms where data from observations and experiments are collected, and open access to publications and databases.

Scientists from Russia, Belarus, and Norway spoke at the webinar.

The list of topics for discussion included:

1. Changes in Arctic ecology under changing climate with more active development of the Arctic shelf and shipping along the Northern Sea Route.

2. Impact of permafrost melting on Arctic and Subarctic ecosystems.

3. Variability of heat and mass transfer between the ocean and the atmosphere because of Arctic sea ice melting.

4. Variability in the formation of Arctic cyclones and their impact on weather in Europe and Asia.

5. Impact of climate change on the flow of northern rivers and moisture and precipitation regimes.

6. Unstable frequency of hazardous weather events in a changing climate.

7. Changes in sea currents in the context of climate change.

8. Changes in ocean salinity and marine biogeochemical processes and their impact on ocean bioproductivity.

- Opening remarks
  - Anton Vasiliev, Deputy Director, Center for Arctic and Climate Studies RSHU
  - Andrey Bryksenkov, Director of the representative office of the RSHU in Moscow
  - Denis Leontiev, Vice-Rector for Development and Research of the RSHU
- Announcement of upcoming events scheduled for ASM4
  - Andrey Bryksenkov, Director of the representative office of the RSHU in Moscow
- Report on the topic: "Research collaboration is existentially important for Norway and Russia - an interdisciplinary dialogue about the future of the Arctic could be a salvation"
  - Andrey Mineev, Ph.D, Arctic expert (Norway)
- Report on the topic: "International cooperation in the Arctic"
  - Gennady Aronov, Cand. Phys.-Math. Sc., Director of the Center for Geophysical Monitoring of the National Academy of Sciences of Belarus (Republic of Belarus)
- Report on the topic: "Research of physical, chemical and biological processes in the atmosphere and hydrosphere in conditions of climate change and anthropogenic impacts"
  - Sergey Smyshlyaev, Dr. Phys.-Math. Sc., Professor of the Department of Meteorological Forecasts of the RSHU (Russia)

2. Linking Past and Present Marine Ecosystems. Exploring the Marine Environment

The second webinar "Linking Past and Present Marine Ecosystems. Studying the Marine Environment" was held on the online platform of the Russian State Hydrometeorological University.

As the speakers noted: According to observational data, over the past 30 years, the Arctic has been heating up about twice as fast as the entire globe. Most scientists agree that such rapid warming is a signal of anthropogenic climate change.

The first report was made by A.A. Bryksenkov, Director of the Russian State Hydrometeorological University in Moscow, it was devoted to "Climate change and ocean ecosystem" It proposed to pay attention first of all to complex ecological and climatic monitoring of environment and Arctic ecosystems, including specially protected natural areas, monitoring of climate change processes in the Arctic and exchange of best practices of circumpolar countries in developing adaptation strategies to climate change as one of possible indicators of telecommunication and economy as a whole in the Arctic region.

Dr. Alexandra Middleton, PhD in Economics and Business Administration made the next presentation from the University of Oulu. Her presentation focused on the feasibility of container shipping along the Northern Sea Route. Important measures to protect the Arctic could include e.g. commitments to reduce black carbon emissions, investments in greener ships, sustainable business models based on closed-loop economics, and mitigating the environmental impact of container traffic through the Suez Canal.

The third report was made by Alexandra Ershova, Candidate of Geographical Sciences, Associate Professor of Ecology, Nature Management and Environmental Safety Department of Russian State Hydrometeorological University, and was devoted to monitoring of plastic pollution in the Arctic. The report concludes that the level of pollution by microplastic particles of the studied seas is most likely related to the intensity of marine activities carried out in their waters. However, the contribution of other sources of microplastics - in the waters of the Atlantic and Pacific Ocean, the effluents of major Siberian Rivers - has yet to be assessed. Investigations of microplastics content in the marine environment are developing worldwide very actively: different methods of marine water sampling for its particles content are being used. Comparison of investigations carried out both abroad and in Russia shows that the method of microplastics sampling strongly depends on the type of water body, its biological productivity, level of pollution, as well as on technical capabilities of field studies. All this points to the need for mutual calibration of sampling methods and further research for more accurate quantitative and qualitative assessment of Arctic seas pollution by microplastics. Development of a unified methodology should solve the problem of comparability of measurement data.

The fourth presentation was made by Raj Kumar Srivastava, Deputy Head of Mission, who participated in the seminar on Arctic governance organized by the Sasakawa Peace Foundation. The main theses of his speech were: India intends to expand its presence in the Arctic by increasing investments into prospective projects and development of climatic research. Russia and India can act as allies in this sphere. Russia is interested in India joining the development of natural resources in the Russian Arctic, especially in the face of Western sanctions. Cooperation with Delhi will allow Moscow to significantly increase the export potential of the countries, expand the geography of supplies, diversify markets and partially compensate for losses due to external restrictions.

Indian partners do not have much experience in developing offshore fields in harsh climates, but today the Russian oil industry needs an additional source of investment. Unlike such scientific fields as climatology and oceanography, in India there is no fully-fledged Arctic political and economical school yet. The problem is dealt with by a very limited circle of specialists, for whom it is not the main one. It seems that further expansion of the discussion of the Arctic exploration in the Indian expert community will give impetus to the whole Indian Arctic program.

The last presentation was made by Stanislav Martyanov, PhD in Physics and Mathematics, a researcher at the Laboratory for Modelling Ocean Biogeochemical Cycles, St. Petersburg Branch of the IO RAS. His report was titled: "Studying the influence of river flow on the thermohaline structure and primary production of phytoplankton in the Kara Sea using high resolution numerical modeling". The floating sea ice cover of the Arctic Ocean is shrinking, especially in summer. Glaciers in Russia, Alaska, Greenland and northern Canada are retreating. Warm waters of Atlantic currents create a special hydrological regime: Norway, West Spitsbergen, North Cape.

- Opening remarks
  - Anton Vasiliev, Deputy Director, Center for Arctic and Climate Studies RSHU
- Announcement of upcoming events scheduled for ASM4
  - Denis Leontiev, Vice-Rector for Development and Research of the RSHU
- Report on the topic: "Climate change and the ocean ecosystem"
  - Andrey Bryksenkov, Director of the representative office of the RSHU in Moscow
- Report on the topic: "The feasibility of container transportation along the Northern Sea Route (NSR)"
  - Dr. Alexandra Middleton, PhD in Economics and Business Management from the University of Oulu
- Report on the topic: "The level of contamination with microplastic particles of the studied seas"
  - Alexandra Ershova, PhD in Geography, Associate Professor of the Department of Ecology, Nature Management and Environmental Safety of RSHU
- Report on the topic: "The Arctic investments in promising projects and developing climate research"
  - Raj Kumar Srivastava, Deputy Chief of Mission attended the workshop on Arctic Governance organized by the Sasakawa Peace Foundation
- Report on the topic: "Studying the effect of river runoff on the thermohaline structure and primary production of phytoplankton in the Kara Sea using high-resolution numerical modeling"
  - Stanislav Martyanov, Ph. D. in Physical and Mathematical Sciences, Researcher at the Laboratory for Modeling Ocean Biogeochemical Cycles of St. Petersburg Branch of IO RAS

It is proposed by the participants of the webinar to pay attention primarily to the integrated ecological and climatic monitoring of the state of the environment and Arctic ecosystems, including specially protected natural areas, monitoring of climate change processes in the Arctic and the exchange of best practices of circumpolar countries in the development of strategies for adaptation to climate change.

"Modern polar research is international in nature: it is carried out by different countries, international and national institutes and organizations, united by the network principle".

The webinar moderator Andrey Bryksenkov

3. Conserving Biodiversity of Ecosystems in the Arctic Zone

The webinar "Conservation of biological diversity of ecosystems in the Arctic zone" was held on December 22, 2022 on the online platform of the Russian State Hydrometeorological University, RSMU. This webinar is devoted to general issues of the state and conservation of ecosystems in the Arctic region and the northern seas.

- Opening remarks
  - Anton Vasiliev, Deputy Director, Center for Arctic and Climate Studies RSHU
- Announcement of upcoming events scheduled for ASM4
  - Denis Leontiev, Vice-Rector for Development and Research of the RSHU
- Report on the topic: "Climate change and the ocean ecosystem"
  - PhD Professor Mikhail Shilin (RSHU)
- Report on the topic: "Particularly ecologically significant areas for key marine mammal and polar bear species in the Russian Arctic"
  - PhD Professor Stanislav Belikov, PhD Professor Ruslan Butovsky, «VNII Ecology» (Russia)
- Report on the topic: "Diversity and potential ecological roles of viruses in the Nordic Sea and Laptev Sea"
  - Professor, Caixia Wang, College of Oceanic and Atmospheric Sciences, Director, International Office of Graduate School,Ocean University of China (China)
- Report on the topic: "Avifauna as an indicator of the impact of man-made objects on the ecosystems of the coastal zone on the example of the Murmansk region"
  - PhD Professor Mikhail Shilin RSHU
- Report on the topic: "Programs for the biodiversity study in the Arctic, implemented in the Institute of Ecology of the Russian Academy of Sciences"
  - PhD Ilya Mordvintsev, Institute of Ecology and Evolution named after A.N. Severtsov Russian Academy of Sciences (Russia)
- Report on the topic: "Biological diversity in the Arctic region. Climatic and environmental factors"
  - PhD Alexey Yarotov, Belarusian Geographical Society (Belarus)

4. Indigenous Peoples and the Environment

The webinar "Indigenous Peoples and the Environment" was held On January 24, 2023 on the WGTM online platform as part of ASM4.

During the webinar, the speakers noted that indigenous peoples have followed and continue to follow the path of sparing use of environmental resources and minimal impact on nature. Their economic activities are based on the thoughtful observation of natural processes and the desire to harmoniously integrate the human world into the natural world.

Photo: www.moscow.rshu.ru

Indigenous peoples can maintain their traditional way of life only in undisturbed or weakly disturbed landscapes, so one of the main conditions for their existence is to maintain the level of biodiversity and productivity of lands. They have been coping with such a complicated problem for many thousands of years.

A problematic element of the socio-economic system in today's Russia is the organization of cooperation between indigenous communities of the North and large businesses that operate in the regions of the economic activity in regions of the North.

Conflicts are particularly acute where nature-exploiting companies, primarily mining companies, operate. Development of a mineral deposit affects an important area of the indigenous population's economic life - lands, pastures, and biological resources. Therefore, the search for mutual compromises in the use of the natural resource base, the introduction of new resource-saving technologies, fair compensation for the damage caused, and a well-considered state regional policy remain topical issues, which determine the sustainability of indigenous peoples' development.

Indigenous peoples are characterized by increased observation and sensitivity to climate change and other environmental changes, which allowed them to find ways of cultural adaptation based on their own, traditional, knowledge passed down from generation to generation.

5. Mastering the Arctic by Gaining Knowledge. Accessibility of Education in the Arctic

Webinar "Mastering the Arctic by Gaining Knowledge. Accessibility of Education in the Arctic" was held on February 27, 2023 on the online platform of RSMU as part of ASM4.

The webinar was moderated by: Anton Vasiliev, Deputy Director of the Center for Arctic and Climate Studies at RSMU, and Andrey Bryksenkov, Director of the RSMU office in Moscow.

In his opening remarks, Andrey Bryksenkov noted that the development of the Arctic regions and the Far East are currently in the foreground.

Improving the quality of life is directly linked to the development of education and training. Moreover, the key direction of work in this part - is to ensure the availability of social services, including quality educational services.

In his speech Alexander Saburov, Director of the Arctic Center for Strategic Research of the Federal State Educational Institution of Higher Professional Education

"In his speech, Alexander Saburov, Director of the Arctic Centre for Strategic Studies of Lomonosov Northern (Arctic) Federal University, pointed out that the expeditionary scientific and educational project "Arctic Floating University", since its creation in 2012, had held 15 expeditions, which were attended by 733 participants from 17 countries. Educational programs of the project are aimed at obtaining new knowledge, practice-oriented training of specialists, and popularization of the Arctic exploration.

The great demand for the project should be noted, but the number of students who can participate in expeditions is limited, and therefore it is necessary to scale up the project, both on the northern seas, and on the coastal and island territories.

In the course of the webinar were discussed the relevant issues of scientific, educational and research activities in the Arctic.

Alexandra Ershova, Associate Professor of Geoecology, Nature Management and Environmental Safety Department of RSMU in her report, also dwelled on the training-research using the experience of PlastikLab. RSMU worked out special training programs in the following areas: climatology, climate of Polar regions, marine ecosystems modeling, satellite hydrometeorology, ocean-logical support of transport infrastructure of the Arctic seas.

Innovation technologies are the driver of social and economic development of the polar macro-region. There is a need for specialists, who will create and implement innovative technologies of Russian developers for the needs of the Arctic.

It was noted that the established scientific and educational centers based on leading universities in the Arctic zone of Russia play an important role in the process of youth involvement into science, but there is insufficient cooperation between educational institutions and industrial companies operating in the territory and conducting economic activity.

Other speakers pointed out a number of problems, including: "very few students get practical training in the Arctic. It is necessary to more actively develop interaction between educational organizations and research institutions: Roshydromet, The Arctic and Antarctic Research Institute, Main Geophysical Observatory, Shirshov Institute of Oceanology. It is necessary to develop cooperation between educational organizations and research institutions: Roshydromet, AARI, Main Geophysical Observatory, Shirshov Institute of Oceanology, Tayfun and others. It is necessary to develop a system of target recruitment and training of specialists, as well as a system of motivation for young people who want to stay and work in the Arctic.

Forwarding in 2023 the authority in the Arctic Council of Norway, it is important to emphasize that Russia is an Arctic northern power, which carries out great work in all directions, including education and training.

6. Monitoring and Research on Climate Change in the Arctic Region. Assessing the challenges of Arctic pollution and climate change

The webinar was held on March 21, 2023 on the online platform of RSMU as part of ASM4.

Anton Vasilyev, Deputy Director of the Center for Arctic and Climate Studies of RSMU, and Andrey Bryksenkov, Director of RSMU Moscow office, moderated the webinar.

In his opening speech, Andrey Bryksenkov noted that climate change has a devastating effect not only on the environment in the Arctic, but also has a direct impact on the economic situation of the Arctic countries. The amount of ice has decreased especially in the Russian part of the Arctic.

In addition, because of climate change, Arctic communities are losing their identity. Many of them are highly dependent on Arctic nature - rapid climate change deprives reindeer herders, hunters and fishermen of their livelihood. At the same time, such climatic changes require considerable state investments to maintain stable ecological situation.

In her speech Maria Pitukhina, Doctor of Political Science, Professor of PetrSU, IE KSC RAS dwelled on environmental problems in single-industry towns of the Arctic and environmental agendas of leading city-forming enterprises, The participants of the conference discussed the environmental issues of the leading Arctic monotowns, which are part of the holdings of MMC Norilsk Nickel (Norilsk, Monchegorsk, Dudinka), Rusal (Nadvoitsy, Nickel), PhosAgro (Kirovsk), Segezha group (Onega, Segezha), Polymetal (Pevek).

During the webinar were discussed current issues of the climate agenda in the Arctic. So Oleg Tolstoguzov, Doctor of Economics, Karelian Research Center of RAS drew attention to the fact that global climate changes in combination with the modern pace of economic development create new challenges for the ecological security of the country.

By the example of the state of the ornithofauna of the coastal zone of the Murmansk region, Mikhail Shilin, Doctor of Geographical Sciences, Professor of Russian State Hydrometeorological University, considered the peculiarities of the influence of anthropogenic and climatic factors on ecosystems in the region. His work included research of indicator capabilities of ornithofauna to assess natural and environmental sustainability of Arctic territorial objects, conservation and restoration of vulnerable coastal marine ecosystems under conditions of climatic changes in the Arctic.

The other speakers noted that the Arctic region is a vivid example of transformation of scientific problems into political ones. This refers to interstate problems associated with the search and extraction of energy resources, the use of sea transport routes and biological resources, the delimitation of the continental shelf, the state of the environment, and logistics corridors.

These processes are reflected in the Climate Doctrine of the Russian Federation. The scientific basis of which is laid by professional research conducted by domestic and foreign climatologists.

Photographer: Anton Vasiliev
Russia

Photographer: Vasily Iakovlev
Rybachiy Peninsula (Murmansk, Russia)

MOVING FORWARD

MOVING FORWARD

AREAS OF RESEARCH PROJECTS IN THE DEVELOPMENT OF SCIENTIFIC AND EDUCATIONAL COOPERATION

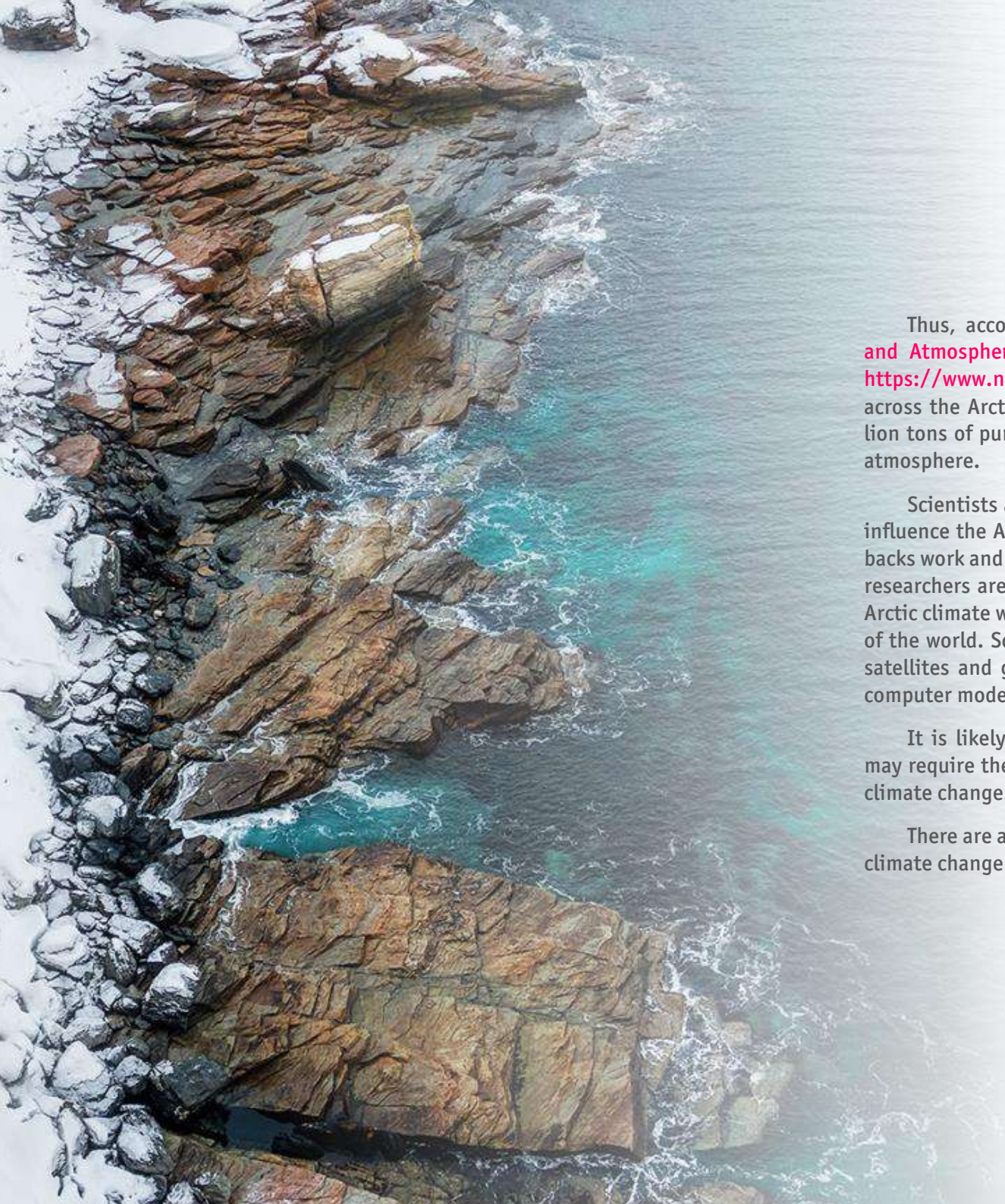
Over the past 30 years, the Arctic has been warming about twice as fast as the entire globe, according to observations. Most scientists agree that this rapid warming is a signal of anthropogenic climate change.

The floating sea ice cover of the Arctic Ocean is shrinking, especially in summer. Glaciers in Alaska, Greenland and northern Canada are retreating. In addition, the frozen ground in the Arctic, known as permafrost, is warming up and thawing in many areas. Scientists first began to see evidence of Arctic climate change in the 1980s. Since then, the changes have become much more pronounced.

Changes in the Arctic are worrying because they could lead to effects that lead to further warming. For example, when white sea ice melts in the summer, patches of dark open water are exposed that can absorb more heat from the sun.

Permafrost can also be involved in feedbacks. As the permafrost thaws, plants and animals that have been frozen in the ground begin to decompose. As they decay, they release carbon dioxide and methane back into the atmosphere, which could contribute to further warming. Changing Arctic vegetation also affects surface brightness, which then affects warming. As the Arctic atmosphere warms, it can hold more water vapor, an important greenhouse gas.

Predicting the Arctic climate is difficult. Some of the changes in the Arctic may also be due to feedback effects or effects that reduce the amount of warming. For example, if warm temperatures make the Arctic growing season longer, more plants can survive and absorb more carbon from the air. However, most evidence suggests that the positive feedback effects that accelerate warming outweigh the negative feedbacks.



Thus, according to the 2019 Arctic Oceanic and Atmospheric Administration (NOAA) report https://www.noaa.gov/, permafrost melting across the Arctic can release about 300-600 million tons of pure carbon per year into the Earth's atmosphere.

Scientists are studying the many factors that influence the Arctic climate to find out how feedbacks work and what will happen in the future. The researchers are also studying how changes in the Arctic climate will affect the climate in other parts of the world. Scientists study data collected from satellites and ground stations, and use complex computer models.

It is likely that extreme climatic conditions may require the ability to adapt as well as abrupt climate change.

There are a number of hypotheses about what climate change can lead to.

Curious (from our point of view) is the hypothesis indicated in the works of V.I. Vernadsky, S.M. Shirokogorov, and developed by Yu.V. Bromley, L.N. Gumilyov and S.Yu. Malkov - the theory of passionarity (explosions of historical and economic activity L.N. Gumilyov called passionary shocks) and ethnogenesis (the process of the formation of an ethnic community) - which describes the historical process as the interaction of developing ethnic groups with a "shifting landscape" (climate) and other ethnic groups.

One of the reasons for "passionary shocks" is proposed to be a sharp shift in climatic zones. Climatic conditions may also require the ability to adapt. The restructuring of the climate divides the ethnic groups into those that were able to adapt to the new conditions, and those that were unable to do so.

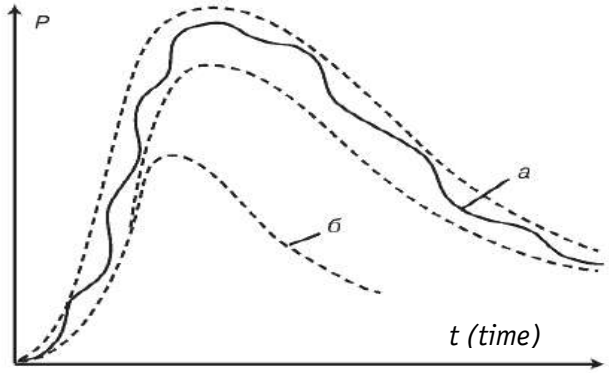


Figure 7: Model of development of "passionate push" depending on time

According to the theory, during periods of cooling, the zones of passionary shocks shift to the south, and during periods of warming, to the north. In Europe, climate change, and hence the latitude at which a passionary push can appear, is controlled by the Gulf Stream. Gumilyov has repeatedly written about how cycles of climate change give rise to cycles of activity.

According to the authors, passionarity, described as a behavioral phenomenon, has an energy nature: the ability of an individual to perform purposeful work to change the environment (which requires a long emotional, volitional, intellectual, and often-physical strain) is explained by the increased amount of energy that this individual captures (absorbs) from the environment. This conclusion is a consequence of the law of conservation of energy, according to which the energy necessary to perform a certain work cannot appear out of nowhere. In this connection, the question naturally arises about the form of the energy in question and the mechanism of its absorption. According to this theory, it is quite possible that climate change in the Arctic and the associated increase in passionarity will provide a sharp impetus to the economic and social development of the Arctic region.

Thus, it is proposed to pay attention first of all to integrated environmental and climatic monitoring of environmental conditions and Arctic ecosystems, including specially protected natural territories, monitoring of climate change processes in the Arctic and exchange of best practices of circumpolar countries in developing adaptation strategies to climate change.

Russia is currently developing international cooperation on climate change research in the Arctic and was the chairman of the Arctic Council until 2023. Thus our country coordinated the activities of the Ministerial meetings on the development of science in the Arctic, and the Russian State Hydro-Meteorological University (RSHMU) was appointed responsible for these activities.

Today RSMU continues to perform a wide range of fundamental and applied world-class research on the "ocean-sea-ice-atmosphere" system, including extreme phenomena and processes (polar cyclones, waves, sea ice, etc.) on the basis of the leading research laboratories and institutes of the University.

The scientists involved in the work of ASM4 regularly published the results of their work in scientific journals and presented them at international scientific conferences.

During the presentations, the issues of the possibility of increasing the potential in the field of science and education for the inhabitants of the Arctic, including indigenous communities, were considered, recognizing the importance of the practical use of their knowledge within their education system. Adapting education systems to include traditional and local knowledge is essential for Arctic residents to build resilience in their changing environment.

As part of the ASM4 webinars, we tried to promote scientific collective approaches to ensuring the sustainable development of the Arctic region. It is imperative that people around the world perceive the Arctic as something related to their lives, and not as a distant and uncomfortable territory.

It is also critical to build science and education capacity for Arctic residents, including indigenous communities, recognizing the importance of putting their knowledge into practice within their education system. Adapting education systems to include traditional and local knowledge is essential for Arctic residents to build resilience in their changing environment.

Further strengthening of activities for the development of scientific and educational cooperation with the countries of the Arctic region is seen as relevant.

Photographer: Vasily Iakovlev
Finland

Photographer: Vasily Iakovlev
Russia

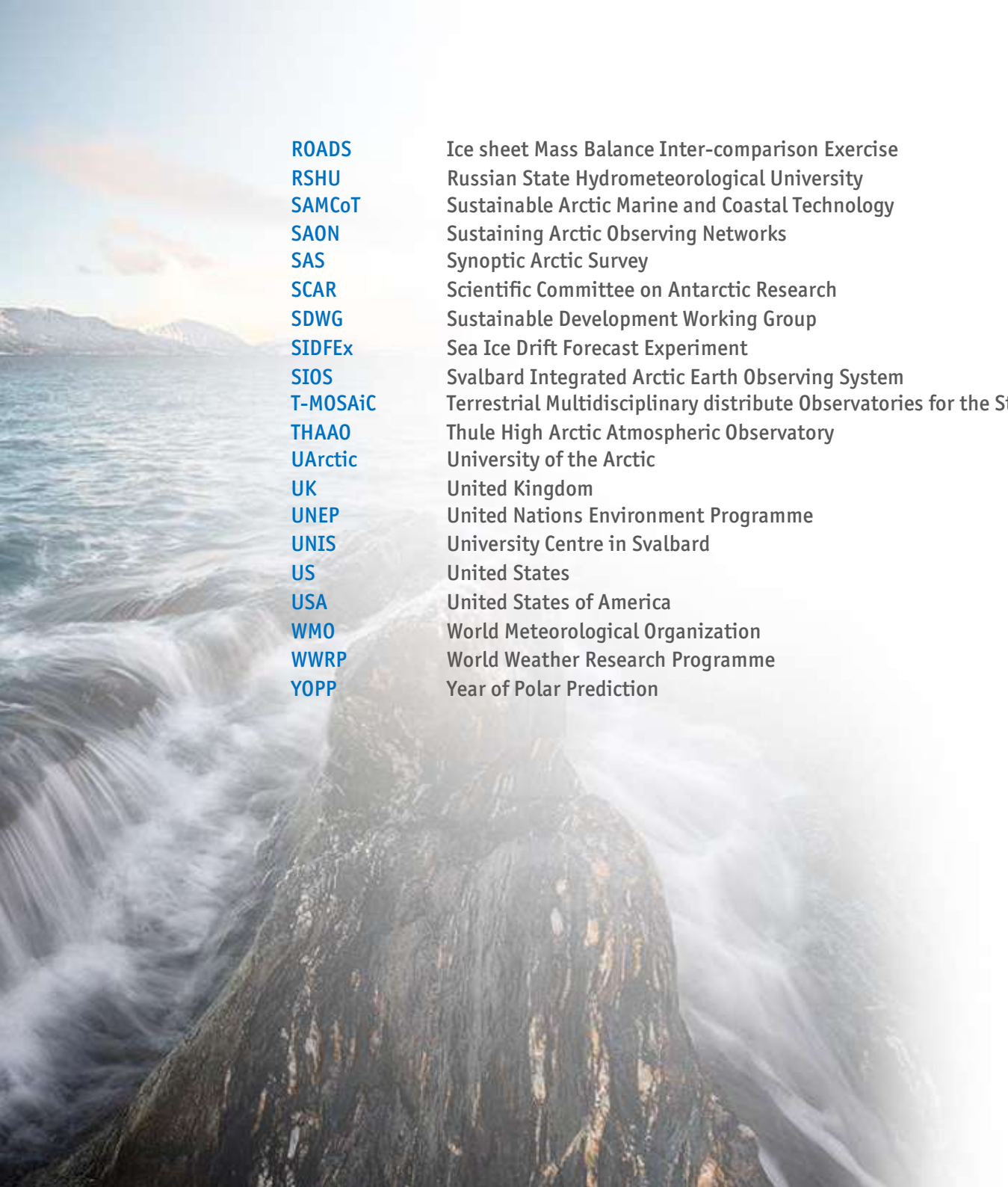
ACRONYMS

ACRONYMS

ABDS	Arctic Biodiversity Data Service
ABoVE	Arctic Boreal Vulnerability Experiment
ACAP	Arctic Contaminants Action Program
ACGF	Arctic Coast Guard Forum
ACRoBEAR	Arctic Community Resilience to Boreal Environmental change: Assessing Risks
AHEAD	Arctic Hydrogen Energy Applications and Demonstrations
AIVAN	Arctic Indigenous Virtual Arts Network
AMAP	Arctic Monitoring and Assessment Programme
AOS	Arctic Observing Summit
APECS	Association of Polar Early Career Scientists
APPLICATE	Advanced Prediction in Polar regions and beyond: modelling, observing system design and Linkages associated with a Changing Arctic climate
ARCPATH	Arctic Climate Predictions: Pathways to Resilient, Sustainable Societies
ArcRCC-N	Arctic Regional Climate Centre Network
ARCSAR	Arctic and North Atlantic Security and Emergency Preparedness Network
Arctic-FROST	Arctic FRontiers Of SusTainability: Resources, Societies, Environments and Development in the Changing North
ARENAII	Arctic Remote Energy Networks Academy
ARC	Arctic Research Center
ARICE	Arctic Research Icebreaker Consortium
ASM	Arctic Science Ministerial
ASM1	First Arctic Science Ministerial
ASM2	Second Arctic Science Ministerial
ASM3	Third Arctic Science Ministerial
ASM4	Fourth Arctic Science Ministerial
ASSW	Arctic Science Summit Week
ASTRA	Arctic Space Training
CAFF	Conservation of Arctic Flora and Fauna
CAPARDUS	Capacity-building in Arctic standardization development
CAPEC	Capacity-building in Arctic standardization development CircumArctic Permafrost Environment Change Monitoring, Future Prediction and development Techniques of useful biomaterials
CARE	Collect benefit, Authority to control, Responsibility and Ethics
CBMP	Circumpolar Biodiversity Monitoring Programme

CHARTER	Changes in Arctic Terrestrial Biodiversity
CLEO	Circumpolar Local Environmental Observation Network
COSMOS	Continuous Soot Monitoring System
COVID-19	Corona Virus Disease 2019
CROW	Canadian Rangers Ocean Watch
CryoSat-2	Earth Explorer CryoSat mission 2
DBO	Distributed Biological Observatory
DMI	Danish Meteorological Institute
EALLU	'herd' in Sámi
EastGRIP	East Greenland Ice-core Project
ECOTIP	ECOogical TIPping cascades in the Arctic Seas
Edu-Arctic	Engaging students in STEM education through Arctic research
EPB	European Polar Board
ESA	European Space Agency
EU	European Union
EU-PolarNet	European network to co-develop and advance European Polar Research
FACE-IT	Future of Arctic Coastal Ecosystems – Identifying Transitions
FAIR	Findable, Accessible, Interoperable, and Reusable
FAO	Food and Agriculture Organization of the United Nations
FARO	Forum of Arctic Research Operators
GEO	Group on Earth Observations
GIOS	Greenland Integrated Observing System
GLIDER	Unmanned Ocean Exploration Project
GRACE-FO	Gravity Recovery and Climate Experiment Follow-On
HYPE-ERAS	HYdrology, PErmafrost and resilience in Eastern Russian Arctic and Subarctic
IASC	International Arctic Science Committee
IASSA	International Arctic Social Sciences Association
ICASS	International Congress of Arctic Social Sciences
ICC	Inuit Circumpolar Council
ICE-ARC	Ice, Climate, Economics – Arctic Research on Change
ICES	International Council for the Exploration of the Sea
ID Arctic	Interdisciplinary study of Arctic sea ice changes and impacts for the society

IMBIE	Ice sheet Mass Balance Inter-comparison Exercise
IMO	International Maritime Organization
INTAROS	Integrated Arctic Observation System
INTERACT	International Network for Terrestrial Research and Monitoring in the Arctic
InteRFACE	Interdisciplinary Research for Arctic Coastal Environments
IOC	Intergovernmental Oceanographic Commission of UNESC
IPCC	Intergovernmental Panel on Climate Change
IPICS	International Partnerships for Ice Core Sciences
ISAR-6	6th International Symposium on Arctic Research (ISAR-6)
ISO	International Organization for Standardization
ITK	Inuit Tapiriit Kanatami
J-ARC Net	Japan Arctic Research Network Center
JUSTNORTH	Towards Just, Ethical and Sustainable Arctic Economies, Environments & Societies
KEPLER	Key Environmental monitoring for Polar Latitudes and European Readiness
LEO	Local Environmental Observation Network
MARIS	Multi-Parameters Arctic Environmental Observations and Information Services
MARPART	Maritime Preparedness and International Partnership in the High North
MOSAiC	Multidisciplinary drifting Observatory for the Study of Arctic Climate
NASA	National Aeronautics and Space Administration
NGEE Arctic	Next-Generation Ecosystem Experiment
NISAR	US and Indian Space Research Organisation (ISRO) Synthetic Aperture Radar (SAR)
NISR	National Inuit Strategy on Research
OPEN POLAR	Global Open Access Portal for Research Data and Publications on the Arctic and Antarctic
PANABIO	PAN-Arctic Information System on Marine BIOta
PEEX	Eurasian Pan-Eurasian Experiment
PEI	Polar Educators International
PICES	North Pacific Marine Science Organization
PPP	Polar Prediction Project
PROPOLAR	Portuguese Polar Program
PROTECT	Projecting Sea-Level Rise
RADARSAT	Radar Satellite
RECAP	Renland ice CAP project
ReiGH	Reindeer husbandry in a Globalizing North



ROADS	Ice sheet Mass Balance Inter-comparison Exercise
RSHU	Russian State Hydrometeorological University
SAMCoT	Sustainable Arctic Marine and Coastal Technology
SAON	Sustaining Arctic Observing Networks
SAS	Synoptic Arctic Survey
SCAR	Scientific Committee on Antarctic Research
SDWG	Sustainable Development Working Group
SIDFEx	Sea Ice Drift Forecast Experiment
SIOS	Svalbard Integrated Arctic Earth Observing System
T-MOSAiC	Terrestrial Multidisciplinary distribute Observatories for the Study of Arctic Connections
THAAO	Thule High Arctic Atmospheric Observatory
UArctic	University of the Arctic
UK	United Kingdom
UNEP	United Nations Environment Programme
UNIS	University Centre in Svalbard
US	United States
USA	United States of America
WMO	World Meteorological Organization
WWRP	World Weather Research Programme
YOPP	Year of Polar Prediction

Photographer: Vasily Iakovlev
Russia

APPENDIX

APPENDIX

THE MAIN DIRECTIONS OF DEVELOPMENT OF INTERNATIONAL SCIENTIFIC COOPERATION IN THE ARCTIC

At present, the main directions of development of international scientific cooperation in the Arctic are the following:

- expanding cooperation among universities focused on research in the Arctic;
- creation of northern research centers;
- increased support from research funds for international research in the Arctic.

The very priorities for the topics of Arctic research projects, both Russian and foreign, do not always coincide.

According to our research 67% of the topics covered by the mass media of the western countries with regard to the Arctic are dedicated to climate and environmental problems, 24% to sustainable development, and the rest largely to issues of militarization of the northern regions and issues of the indigenous population. State and societal interests also reflect the focus of the projects.

At present the member states of the Arctic Council have priority in research on environmental issues, climate change, permafrost and the atmosphere, carbon cycles, bird migration, and social and economic aspects of northern regions' development.

Scientific projects implemented by Russian scientists, as well as priority proposals aimed at intensifying international scientific and educational cooperation in the Arctic zone, in our opinion, should correlate with the target indicators of the project to implement the Strategy for Development of the Arctic Zone of the Russian Federation and ensuring national security for the period up to 2035.

Several factors, namely Russia's interest in international cooperation in the Arctic in the last decade, the emergence of most subarctic states, including Russia, of their own "Arctic strategies", as well as the intensification of Russia's appeal to the UN regarding the expansion of the Arctic shelf, have changed the situation in this area. Whereas previously both the number and volume of foreign contributions to investments in scientific cooperation were comparable with Russia's, now they are much lower, yielding to the diversity of areas, geography and financing.

In November 2020, the 3rd Arctic Science Ministerial (ASM3) addressed the question "Exploring Community Input on Gaps and Barriers in International Arctic Research.

It was noted that improving cooperation between scientists and Arctic communities is an integral part of Arctic development. Because observations in the Arctic require significant human resources and costs due to the remoteness and harsh environmental conditions, it is difficult for one country to establish and maintain a long-term observation system. Therefore, there is a need to cooperate to create a system on an international platform to facilitate cooperation in observations and data exchange.

The interrelated effects of globalization and global climate change are affecting Arctic communities and the environment. It is increasingly clear that the Arctic environment is not only a highly complex system in its own right, but is also linked to global weather and climate change, as well as to world socio-economic systems.

International cooperation on comprehensive and holistic Arctic science must be strengthened to better assess current and predict future changes. Knowledge- and research-based decisions need to be made and provide the basis for effective action.

It is therefore crucial to develop proposals for global measures related to slowing down climate change, to find trade-offs between development and conservation in the Arctic, and to support adaptation and mitigation strategies for Arctic residents.

This approach requires making full use of the Arctic knowledge system. The need for proactive, knowledge-based responses was emphasized at the 4th Arctic Science Ministerial (ASM4).

Young scientists and knowledge holders who will be the next generation of leaders need to be encouraged and supported. It is imperative that people around the world see the Arctic as something connected to their lives, not as a remote and uncomfortable place. It is also important to build the educational capacity of Arctic residents, including indigenous communities, recognizing the importance of putting their knowledge into practice within their education system. Adapting education systems to incorporate traditional and local knowledge is necessary for Arctic residents to become more resilient to changing environmental conditions.

With this in mind, it is crucial to further strengthen the development of scientific and educational cooperation with Arctic countries and international projects on Arctic issues.

At the same time, in shaping the topics of international Arctic research projects, the contribution of each participant must be decisive.

CREATING DATABASES FOR THE FUTURE ARCTIC SCIENCE MINISTERIAL

One of the tasks completed as part of the project was to create and populate **the 4th Arctic Science Ministerial (ASM4) website**, provide informational content for the site, and update the data in accordance with the ASM4 work plan (link to the website page at **https://asm4.ru**).

The ASM4 website is designed to generate publicly available resources that contain information about ASM4 activities, and the site contains informational materials, newsfeed publications, and webinar topics from 2022 and 2023 (Section 1).

The site contains an updated database of information on research results in the Arctic. In 2021, the Japanese side initiated the creation of an open information platform to provide access to information on the results of scientific research in the Arctic. Discussion of this issue was previously initiated by the Arctic Council member countries (Iceland, Norway, etc.) with the participation of the permanent members of the Association of Indigenous Peoples of the North. The Russian Federation decided to support the continuity of the policy pursued by Iceland and Japan and to establish interaction with the previous Chairs on updating the information database on scientific research in the Arctic region.

To update the database on Arctic projects, questionnaires requesting information on Arctic projects were sent to various countries and indigenous organizations:

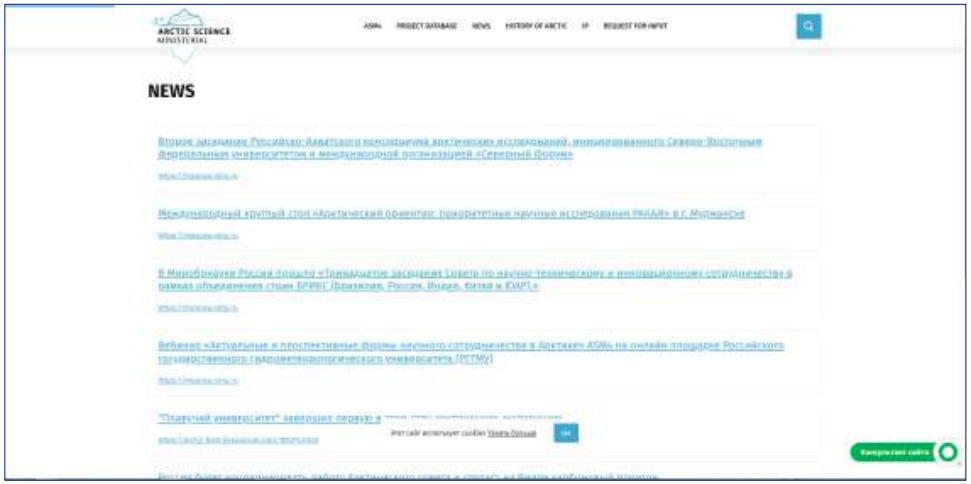
1. Strategic and research goals.
2. Sources of funding for research in the country/organization.
3. Major research initiatives and research infrastructure facilities.

The questionnaires were also posted on the official ASM4 Meeting website under the "Data Entry Request" section.

The site also contains documents from the working group meetings (minutes), online recordings of the meetings, and a draft concept note. All materials are publicly available. If possible, materials are translated into other languages. The final report of the project is also available on the website, which ensures transparency and open access in the creation of the inherited product of Arctic research.

- ASM4. This section summarizes the history of the Arctic Science Ministerial Meetings from 2016 (the first meeting in Washington, DC, USA) through 2023 (the meeting was held in St. Petersburg, Russia).

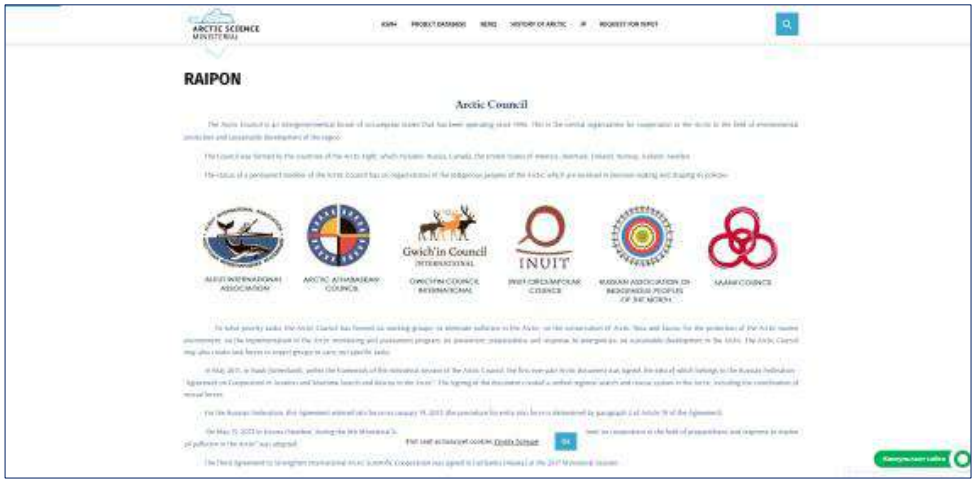
- PROJECT DATABASE. The section contains information from the Arctic research database, which is intended for scientists, indigenous peoples of the North, regional authorities, and other interested parties.



- NEWS. The section contains the main news of the Arctic zone, announcements of events, as well as other publications and materials related to the activities of ASM.

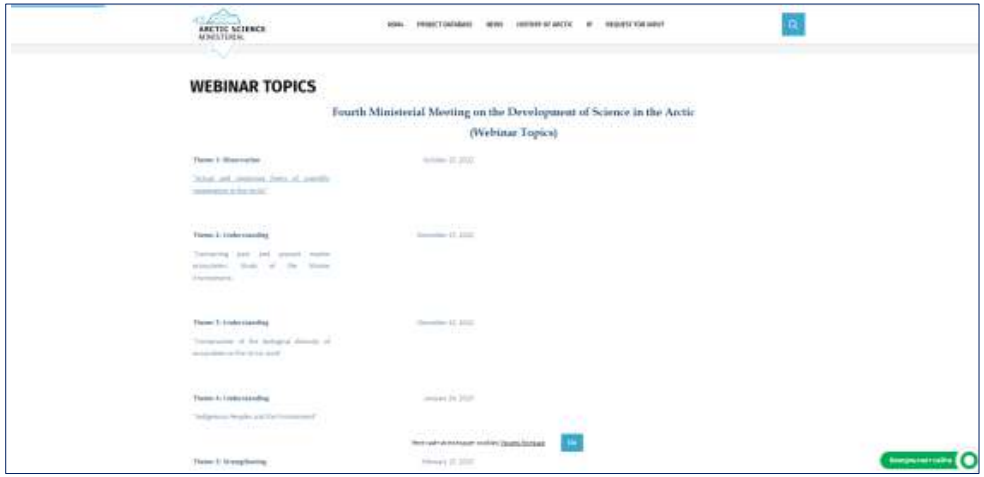
- History of the Arctic. The section describes the history of Arctic exploration, chronology of the main Russian Arctic expeditions since 1648. It also includes a list of great explorers who made a significant contribution to the development of the Arctic.

- Association of Indigenous Peoples of the North, Siberia, and the Far East (RAIPON). The section contains basic information about the Arctic Council and its member countries (the Russian representative is the Russian Association of Indigenous Peoples of the North, Siberia and the Far East of the Russian Federation (RAIPON).

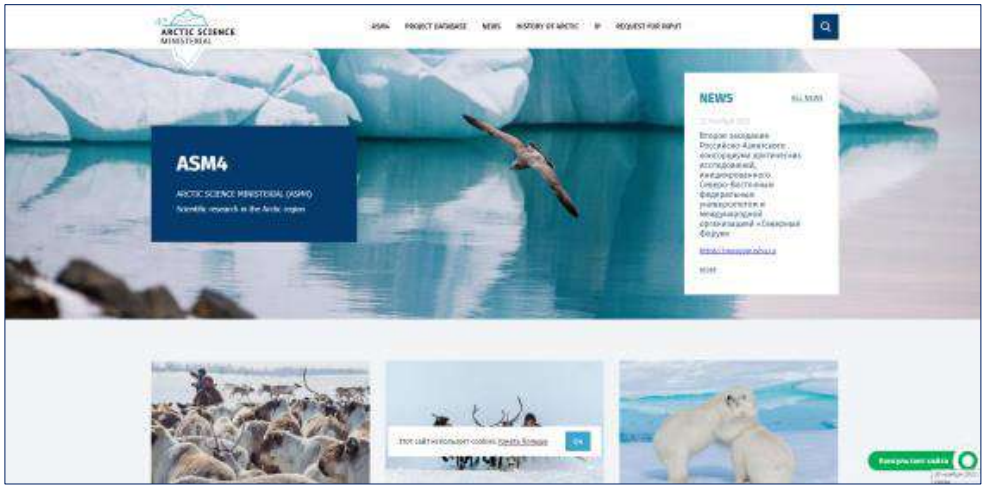


- Data Entry Request. This section of the questionnaire seeks up-to-date information on the results of Arctic research and development projects for the 4th Ministerial Meeting, as well as new initiatives proposed for consideration, including opportunities for support in line with the goals and directions of the upcoming meeting.

- CONCEPT NOTE. The section contains an ASM4 concept note that talks about the goals and objectives accomplished under ASM4.



- TOPICS OF WEBINARS. The section contains information about a series of webinars organized by RSMU, which are devoted to preferred areas of research work in the Arctic. Between October 2022 and March 2023, six webinars were held on priority areas. The section also contains information about public speeches, presentations and photos of the meetings.



- ASM4 REPORT. This section contains the final report of the 4th Arctic Science Ministerial Meeting (ASM4). The report has been made available to the participants of the ASM4 and will be posted on the official website of the event after it has been signed.

Based on the above, it should be noted that international research influences shared policy goals, promotes scientific cooperation across national borders, and paves the way for Arctic states to collectively respond to the new challenges of global climate change and anthropogenic activities in the region.

Many Arctic communities face significant challenges in providing adequate levels of education, health care, energy, communication, and access to transportation networks. These challenges are now exacerbated by negative environmental, climatic and socio-economic changes, many of which are occurring outside the Arctic.

Making progress in these areas is a priority and critical to the region's sustainable development.

The Arctic is experiencing environmental and climate change faster than any other part of the planet, creating significant challenges for people living in the north, and these changes have serious global consequences. Our efforts address challenges that transcend national borders, requiring a higher level of cooperation in the region.

Photographer: Vasily Iakovlev
Russia

Photographer: Vasily Iakovlev
Norway

ANNEX

ANNEX

THE FOURTH ARCTIC SCIENCE MINISTERIAL

PROGRAM

DAY 1	Friday, April 14, 2023	12:00 - 19:00 MSK (09:00 - 16:00 UTC)

MSK	UTC	
15:00	12:00	Start of participant registration
16:00	13:00	Opening ceremony
16:00	13:00	Statement by the Minister of Science and Higher Education of the Russian Federation
16:10	13:10	Welcoming address
16:30	13:30	Russian Chairmanship of ASM4: Summing Up
16:40	13:40	Handover ceremony from the ASM4 (Russia) to the ASM5 (Norway)
16:50	13:50	Announcement of ASM5 by Norway
17:00	14:00	Group Photo. Press approach
17:30	14:30	Reception on behalf of the Minister of Science and Higher Education of the Russian Federation

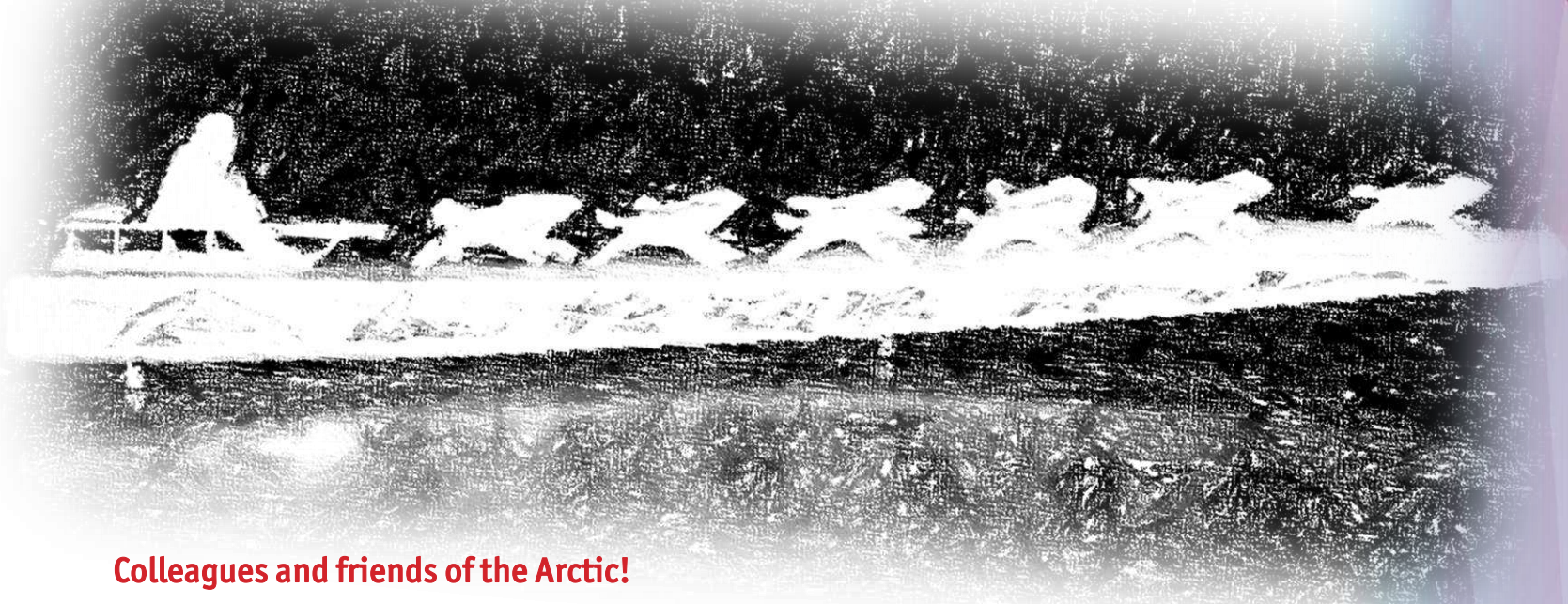
END OF THE FIRST DAY

THE FOURTH ARCTIC SCIENCE MINISTERIAL

PROGRAM

DAY 2		Saturday, April 15, 2023 12:00 - 17:00 MSK (09:00 - 14:00 UTC)
MSK	UTC	
10:30	07:30	Start of participant registration
11:00	08:00	Reporting from Russia on the ASM4 results of its work
11:10	08:10	Speech by Ministers of Science of the Arctic Zone of the Russian Federation
11:40	08:40	Speech by Representatives of ASM member countries
12:00	09:00	Speech by Representatives of Indigenous organizations
12:40	09:40	Speech by Representatives of Non-Arctic States
13:00	10:00	Closing remarks
13:30	10:30	Cultural program
15:00	12:00	Gala dinner
16:00	13:00	End of the Ministerial
END OF THE MINISTERIAL		

ONE DOGSLED,
ONE TEAM!



Colleagues and friends of the Arctic!

The Arctic is experiencing environmental and climate change faster than any other part of the planet, causing significant problems for people in the North. These changes are causing serious global consequences.

Our efforts are aimed at solving problems that transcend national borders, which requires a higher level of cooperation and collaboration in the region, taking into account the diversity of scientific knowledge, cultures and social patterns in the Arctic.

We are confident that **only through cooperation and as part of one team will we be able to achieve the Arctic region's development goals that we all need**.

Sled dogs have always been an example of displaying team spirit, courage, and achieving goals for the residents of the North. The colossal work to develop the North was unthinkable without sled dogs.

Only thanks to the patience, endurance and ingenuity of the dogs of the sled, the most difficult winter passages of the polar explorers were possible.

One dogsled, one team - the motto of cooperation within the framework of the Russian chairmanship of the Arctic Science Ministerial (**ASM**). The emblem of the chairmanship is a team of sled dogs.

We propose to use this emblem, expressing the common efforts to achieve the goal - as a symbol of ASM. In addition, use this sculptural group of a sled dog team as **the symbol of the ASM chairmanship**.

We pass this symbol on to you, our colleagues from Norway, the country which takes over the ASM chairmanship.

We invite everyone to continue to work together to ensure the sustainable development of the Arctic!

The organizers of ***the Fourth Arctic Science Ministerial***
express their deep appreciation to all those who have directly participated in the research work aimed at improving knowledge about the Arctic region, supported the decisions necessary for sustainable development of the Arctic, provided assistance throughout the period of the Russian Federation's chairmanship of the Arctic Council, and for their interest in ASM4 activities and the development and prosperity of the Arctic region!

We express our PERSONAL GRATITUDE:

Yuri TRUTNEV
Deputy Prime Minister and Presidential Plenipotentiary Envoy to the Far Eastern Federal District, Far East and Arctic Development Corporation

Sergey LAVROV
Minister of Foreign Affairs of the Russian Federation

Valery FALKOV
Minister of Science and Higher Education of the Russian Federation

Aleksey CHEKUNKOV
Minister for the Development of the Far East and the Arctic

Aleksandr KOZLOV
Minister of Natural Resources and Environment

Nikolay KORCHUNOV
Ambassador at large of Ministry of Foreign Affairs of Russia, Chairman of Arctic Council Committee of Senior Arctic Officials

Alexander BEGLOV
Governor of St. Petersburg

Dmitry ARTYUKHOV
Governor of the Yamalo-Nenets Autonomous Okrug

Yuri BEZDUDNY
Governor of the Nenets Autonomous Okrug

Roman KOPIN
Governor of Chukotka Autonomous Okrug

Alexander USS
Governor of the Krasnoyarsk region

Aleksandr TSYBULSKY
Governor of Arkhangelsk Oblast

Andrei CHIBIS
Governor of the Murmansk region

Artur PARFENCHIKOV
Head of the Republic of Karelia

Aleksen NIKOLAYEV
Head of the Republic of Sakha (Yakutia)

Vladimir UIBA
Head of the Republic of Komi

Igor SHUMAKOV
Head of Russian Federal Service for Hydrometeorology and Environmental Monitoring

Gennady KRASNIKOV
President of Russian Academy of Science

Artur CHILINGAROV
Special Representative of the Russian President for International Cooperation in the Arctic and Antarctic, President of Interregional Public Organization Association of Polar Explorers

The indispensable contribution of representatives of the Ministry of Science and Higher Education of the Russian Federation should be especially noted and also thanked:

Konstantin MOGILEVSKY
Deputy Minister of Science and Higher Education of the Russian Federation

Alexander TOLPAROV
Director of the Department of International Cooperation, Ministry of Science and Higher Education of the Russian Federation

Sergey TERASHKEVICH
Deputy Director of the Department of International Cooperation of the Russian Ministry of Science and Higher Education

Svetlana SHEVEREVA
Head of the Division of International Scientific and Technical Cooperation and Integration of the Department of International Cooperation of the Ministry of Science and Higher Education of the Russian Federation

Sergey SMIRNOV
Deputy Head of the Division of International Scientific and Technical Cooperation and Integration of the Department of International Cooperation of the Ministry of Science and Higher Education of the Russian Federation

Liana SHAGINYAN
Leading Consultant of the Division of International Scientific and Technical Cooperation and Integration of the Department for International Cooperation of the Ministry of Science and Higher Education of the Russian Federation

Alexander OSTROVSKY
Consultant of the Division of International Scientific and Technical Cooperation and Integration of the Department for International Cooperation of the Ministry of Science and Higher Education of the Russian Federation

In addition, the direct executor of the Arctic activity commitments for the period of Russia's chairmanship of the ASM4 was
the Russian State Hydrometeorological University *and its team:*

Valery MIKHEEV
Rector of the Russian State Hydrometeorological University

Denis LEONTIEV
Vice-Rector for Development and Science of the Russian State Hydrometeorological University

Igor MYASNIKOV
Director of Department of Science, Technology and Innovation RSHU

Anton VASILIEV
Deputy Director of the Center for Arctic and Climate Research of the RSHU

Andrei BRYKSENKOV
Director of the RSHU Representative Office in Moscow

Pavel KONDRAKHIN
Specialist of the RSHU Representative Office in Moscow

Dmitry CHERNYI
Specialist of the RSHU Representative Office in Moscow

Mikhail SERGEEV
Specialist of the RSHU Representative Office in Moscow

Nikita RODIN
Head of the Department of Support and Scientific Activities of the Department of Science, Technology and Innovation RSHU

Eugenia PLATONOVA
Engineer of the Department of Support and Scientific Activities of the RSHU

We also thank to:

Association of Indigenous Peoples of the North, Siberia and Far East of the Russian Federation

Russian Presidential Academy of National Economy and Public Administration

St. Petersburg Committee on Arctic Affairs

Federal Research Center "Kola Scientific Center of the Russian Academy of Sciences"

Federal State Budgetary Scientific Institution "Institute of Lake Studies of the Russian Academy of Sciences"

Moscow State Institute of International Relations of the Russian Ministry of Foreign Affairs

Northern (Arctic) Federal University of P. P. Shirshov (Russian Academy of Sciences)

Federal State Budgetary Institution "Arctic and Antarctic Research Institute"

Far Eastern Federal University

We thank to our team of photographers:

Vasily IAKOVLEV https://vasilyiakovlev.com
Alexey ZHIRUKHIN @bepowerback
Anton VASILIEV

4th ARCTIC SCIENCE MINISTERIAL