

## NORTHERN AND ARCTIC SOCIETIES

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### Contribution of Northern European Universities to the Implementation of Research Policy in the Arctic\*

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**Abstract.** The Arctic region has long been at the center of world politics and economy. One of the reasons for the transformation of the global fringe into a center of attraction for the economic, geo-ecological and geopolitical interests of foreign countries is the Arctic is undergoing dynamic transformations. In the socio-political and scientific research agenda of the Arctic States, there are acute issues of accumulation and exchange of knowledge about changes taking place in the natural and socio-economic environment of a non-standard region from the point of view of management. The Arctic strategies of the Northern European States seek to fill the vacuum about the trends of environmental changes in the Arctic, the impact of natural transformations on the environment, socio-economic development, population security, and the use of natural resources by indigenous peoples. This task is planned to be solved through the development of research activities of universities located in the Far North and in the Arctic zone of Denmark, Norway, Finland and Sweden, as well as Iceland. The article describes the scientific interests of the Northern European States in the Arctic. Using analytical and comparative methods, the goal is achieved — to characterize universities as one of the parts of their scientific and educational space in the Nordic countries. An attempt is made to answer the question: how does educational and research activities contribute to the implementation of state program documents for the development of natural resources in the Arctic and the use of its spaces? The further direction of scientific research may be to compare the educational and research activities of universities in Northern Europe and universities in the Arctic zone of the Russian Federation.

**Keywords:** *Northern Europe, the Arctic, development strategies, research policy, universities.*

### Introduction

In the XXI century, foreign states located both in the Arctic zone (Denmark<sup>1</sup>, Iceland, Canada<sup>2</sup>, Norway<sup>3</sup>, USA<sup>4</sup>, Finland<sup>5</sup>, Sweden<sup>6</sup>), and outside it (China, India, Republic of Korea, Japan, Germany, Great Britain) have developed and updated strategies and programs for the development of national Arctic zones and regions of the Far North.

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<sup>1</sup> Denmark, Greenland and the Faroe Islands: Kingdom of Denmark Strategy for the Arctic 2011–2020. 58 pp.

<sup>2</sup> Canada's Northern Strategy. Our North, Our Heritage, Our Future. Government of Canada, Ottawa, 2009, 48 pp.

<sup>3</sup> The Norwegian Government High North Strategy. Norwegian Ministry of Foreign Affairs, 76 pp. URL: <https://www.regjeringen.no/en/dokumenter/> (accessed 10 May 2020).

<sup>4</sup> National Strategy for the Arctic Region. May 2013. USA, Washington D.C. 13 pp., United States Coast Guard. Arctic Strategy. May 2013. USA, Washington D.C. 48 pp.

<sup>5</sup> Finland's Strategy for the Arctic Region. Government resolution on 2013. Prime Minister Office, 2013. URL: <http://www.hs.fi/english/article/Finland> (accessed 10 May 2020).

<sup>6</sup> Sweden's Strategy for the Arctic region. Government Offices of Sweden. Ministry for Foreign Affairs. Department for Eastern Europe and Central Asia. Arctic Secretariat, Stockholm, Sweden. 2011. 52 pp.

Highlighting similarities in the Arctic strategies, it may be noted that they are based on humanistic principles, which are proposed to be developed using resources of the Arctic zone (regions of the Far North). Foreign countries based their economic activities in the North and the Arctic on the principles of international law. This applies to the issues of delimitation of shelf and island territories, navigation in the Arctic Ocean. At the same time, there are discrepancies in the application of documents. The severity of disputes increases where mineral and biological resources are available and strategic sea routes pass. Countries interested in developing connectivity between the North European and Asia-Pacific regions are seeking to declare the Northern Sea Route (hereinafter — the NSR), the Russian national transport communication in the Arctic, and the Northwest Passage, a significant part of which runs along the coast of Canada, international waters. This is not in the interests of Russia and Canada, respectively.

All strategies proclaim the need to strengthen sovereignty and the role of the Arctic Council in solving the problems of the Arctic region, and emphasize lack of alternatives to this platform for developing a common policy for sustainable development of the Arctic. The Arctic strategies focus not on the Arctic environment conservation, but on the application of advanced science-intensive environmental management standards based on the principles of biodiversity conservation, energy resources usage and alternative energy development which are environmentally safe, consistent with international law. Foreign strategies attach great importance to the prevention of technological accidents in ice-covered areas and indicate the importance of cooperation with indigenous communities in the development of mineral and aquatic biological resources.

Development of science in the North and the Arctic is central point to every Arctic strategy. Priority is given to research in the field of climate change, study of the impact of these processes on ice, ecosystems of the Arctic Ocean and its coast, the use of natural resources by indigenous peoples. The strategies argue for bridging knowledge gaps in natural systems, expanding expeditionary activities, strengthening institutions for transfer of knowledge, competencies and educational technologies, network cooperation, academic and research mobility, and the development of an Arctic Information and Statistical Center ([arcticstat.org](http://arcticstat.org)).

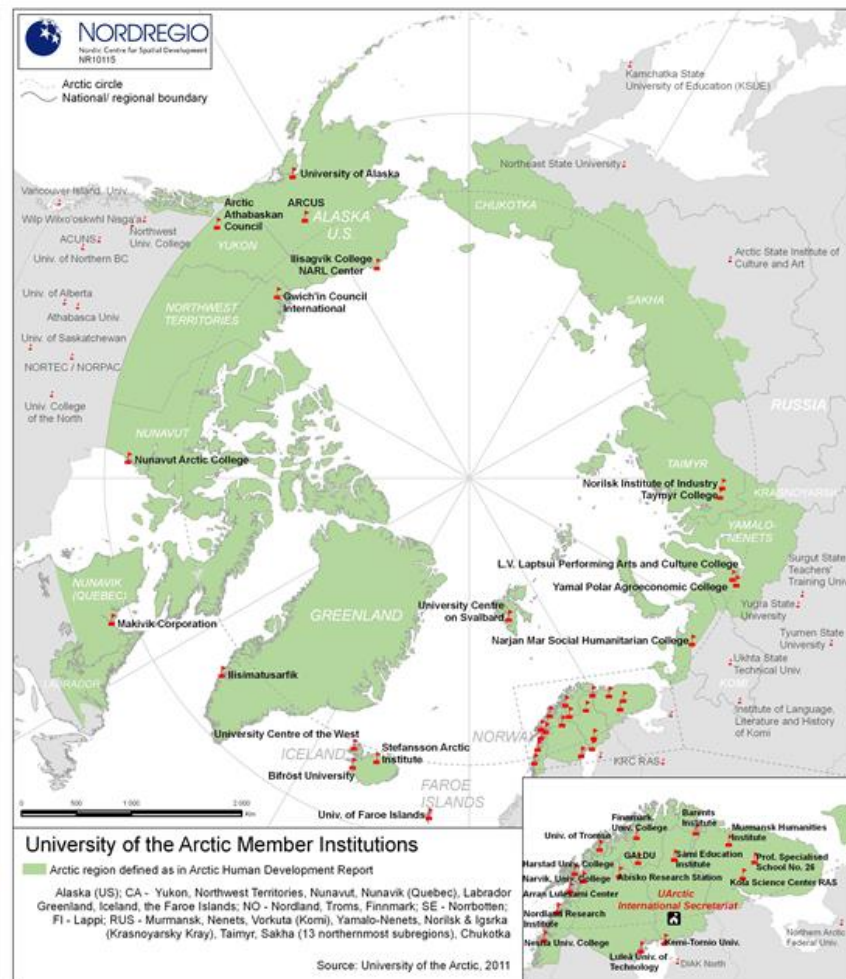


Fig. 1. Arctic universities, 2011 <sup>7</sup>.

At the same time, as fig. 1 indicates, the number of universities in the Arctic region (in the Far North) differs in each Arctic country. Their maximum number is in the countries of Northern Europe, as well as in the Far North of Russia, especially in the Murmansk region. The Secretariat of the University of the Arctic Network is located in Finland. The least developed scientific and educational space with the participation of universities is formed in the Nenets Autonomous Okrug, the entities of the eastern Russian Arctic, as well as in Greenland and the Far North of Canada, which can be explained by the historical features of the settlement and development of these territories.

<sup>7</sup> Nordregio. Maps. Research. URL: <https://archive.nordregio.se/en/Nordregio-Research/index.html> (accessed 10 May 2020).

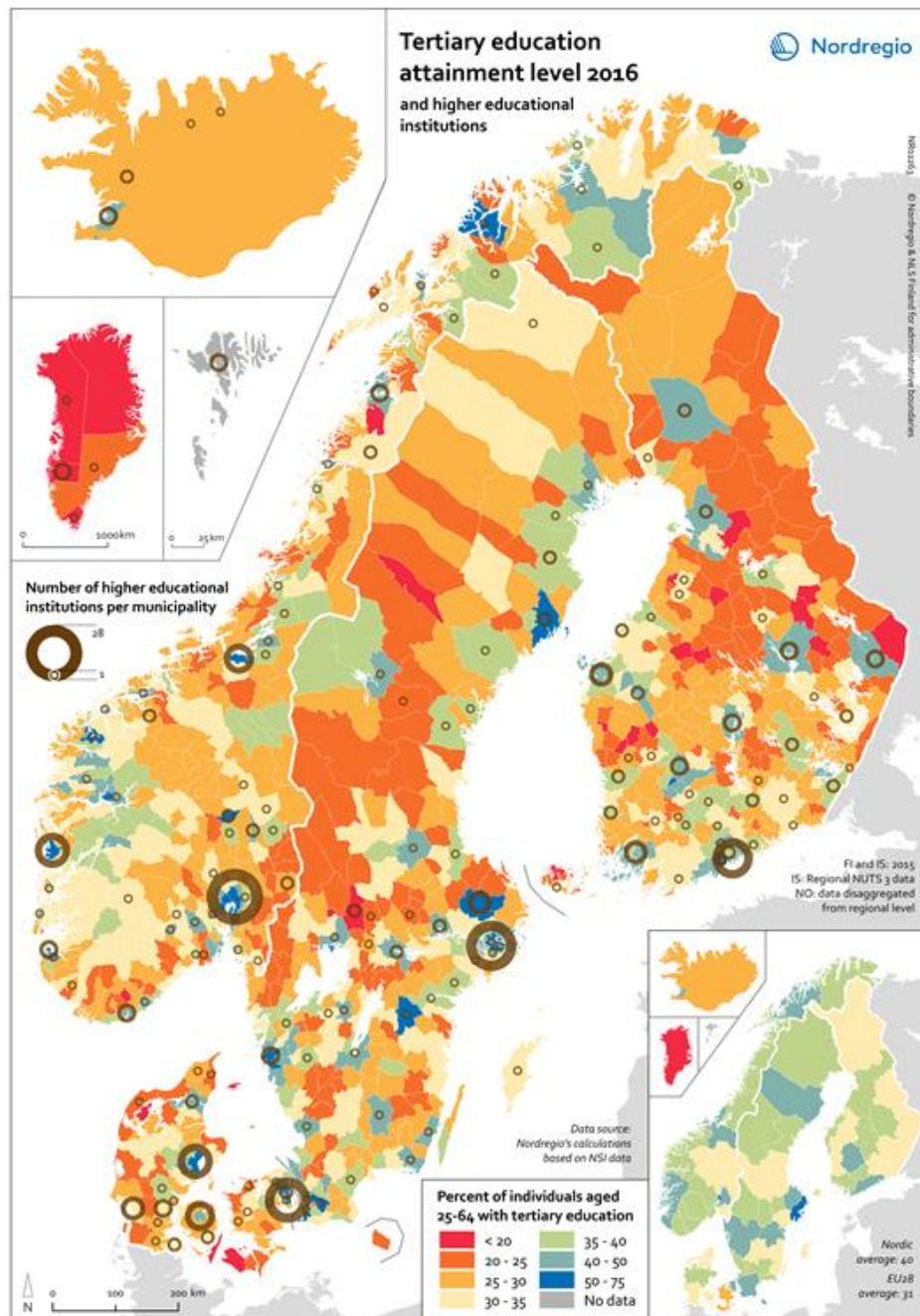


Fig. 2. Number and size of higher education institutions by municipalities in the Nordic countries and the proportion of people with higher education, 2016<sup>8</sup>.

Figure 2 shows that the higher education system in the Far North of Europe is rather undeveloped: universities are located in the central and southern, more comfortable and developed regions of Denmark, Norway, Finland and Sweden. The proportion of people with higher education ranges from 20–25% in municipalities in the High North of Sweden, Finland, Iceland and Greenland and up to 50–75% in the High North of Norway (2016).

<sup>8</sup> Nordregio. Maps. Research. URL: <https://archive.nordregio.se/en/Nordregio-Research/index.html> (accessed 10 May 2020).



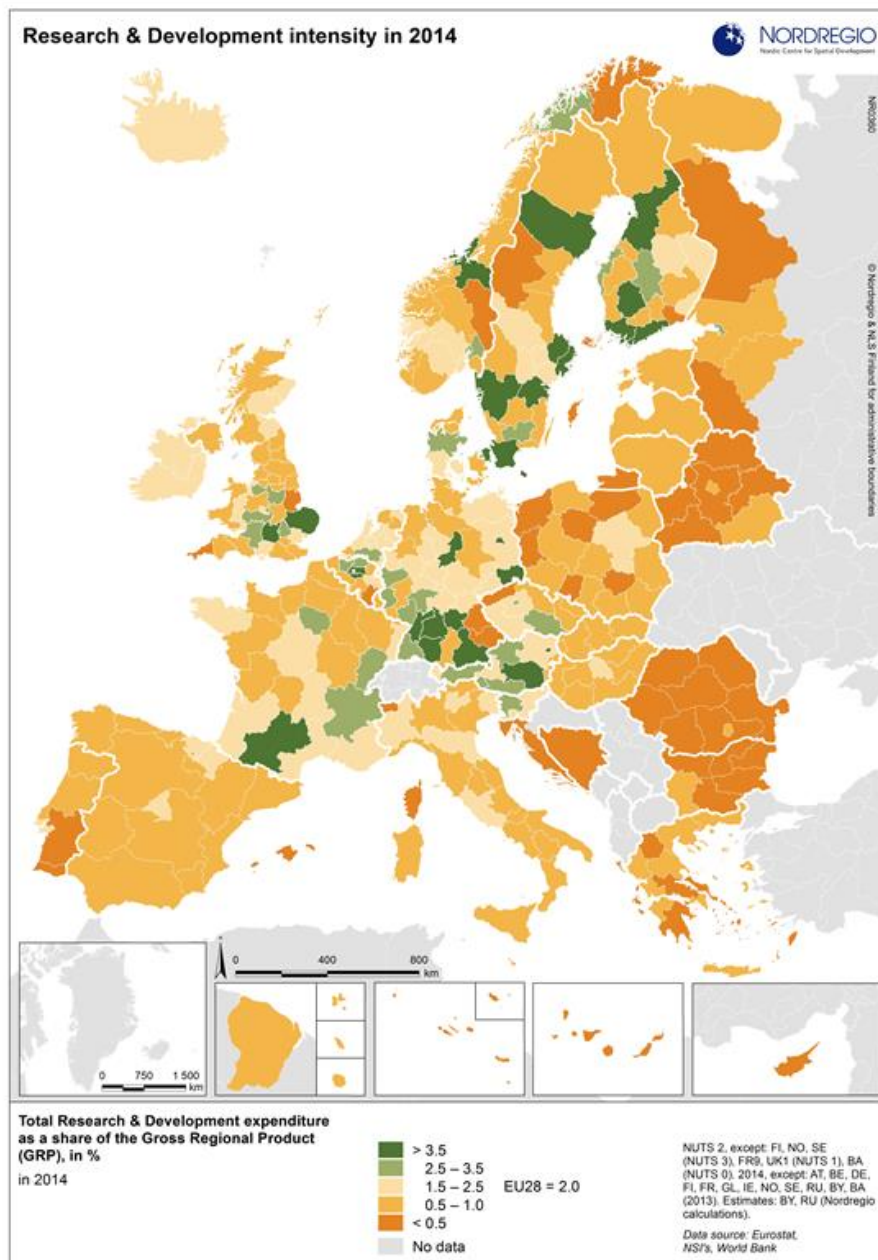


Fig. 3. Share of research and development in GDP of the Nordic countries, 2014 (% of GDP)<sup>9</sup>.

Figure 3 demonstrates the research and development contribution of the Nordic countries to national GDP. On the territories of the Far North of Norway, Finland and Sweden, it varies from 0.5 to 35% and highlights territorial differentiation by entities (counties, provinces, communes), which can be explained by the location of universities

The system of higher education in the northern regions of the studied countries, on the one hand, fits into the national models of higher education; on the other hand, it has specific features. A distinctive feature of the Northern European model of higher education is the predominantly state funding system. The North American model is characterized by minimal interference of government agencies in the development of higher education, a high share of provincial and

<sup>9</sup> Nordregio. Maps. Research. URL: <https://archive.nordregio.se/en/Nordregio-Research/index.html> (accessed 10 May 2020).

regional responsibility, and a variety of sources of funding for the activities of universities. The state policy of the Russian Federation in development of university education is aimed at increasing the competitiveness of higher education and its integration into the world educational space. Reforming and modernizing of higher education in Russia is based on the principles of preserving and developing a unified educational space, which implies a significant role of federal bodies in determining the quality standards for personnel training, striving to link them with professional industry standards.

Rural and remote communities within the circumpolar world face the challenge of providing opportunities for any — from secondary to postgraduate — education at the location of the student due to geographical barriers and lack of available financial and organizational resources. Considerable experience has been accumulated to overcome such isolation [2].

Analysis of the Russian-language literature revealed an information vacuum on the subject of the article. The 2014 Arctic Human Development Report does not cover this topic comprehensively. M.D. Robards, H.P. Huntigton and others discuss knowledge from a philosophical standpoint, characterize the patterns of “joint production of knowledge” in local communities as a response to global climate change, entailing changes in communications and trade. “Attention to local needs, perspectives and cultures is seen as a prerequisite for facilitating effective adaptation planning or, more broadly, the sustainability of local peoples.” “The area of the 'science-policy interface' goes beyond observing or evaluating changes at different scales and perspectives, and defining conditions conducive to the joint production of practical knowledge. This approach requires the development of response tools that can take into account the dynamic relationships between humans, wildlife and habitats that span different cultures, time frames, and sometimes national boundaries” [3, p. 205]. In the changing geoeological, geopolitical and socio-economic conditions in the Arctic region, S. Petrov, N.L. Mamaeva and others discuss the development of environmental education as a means of ensuring safety, rational use of natural resources and sustainable development of the Arctic. “This is especially important in the Far North with difficult climatic conditions (special geomagnetic background, sharp temperature changes, strong winds, permafrost presence, etc.) and the rapid development of the oil and gas complex (in particular, a high accident rate associated with technical devices complexity, extreme operating conditions, strong environmental influences, flammability and explosiveness of extracted products, human factor)...” [4, p. 366]. M.N. Chechurina and V.E. Sokolenko review Norway’s experience of innovative development. They substantiate the conclusion that the key role in technological progress and innovation is played by universities, science-based companies, scientific and technological clusters. The materials of their research are of interest for a similar analysis of the Russian northern regions development and the national economy competitiveness increasing [5]. The article by A. Husebekk examines the role of universities in regional development on the example of the Arctic University of Norway (UiT). “The mission of the university is to promote Norway's Arctic strategy in education, science and technology.” The author emphasizes the influence of the university on regional

development within the Triple Helix model, the focus of studying the economic, cultural and social development of the Far North through increasing knowledge and human capital, international cooperation in the field of education and science [6]. Misund O.A., Aknes D.W. and others study the role of science and education in Svalbard. Scientists analyze the University Center on Svalbard (UNIS), its organization and development since 1993, links with history and politics (in particular, the Treaty on Svalbard of 1920), scientific, educational and human resources, academic production (graduation of students and scientific products), as well as growth potential. The main motivation for the establishment of the center was the creation of an alternative option for the operation of unprofitable, highly subsidized coal mining industry. It is noted that UNIS currently produces at least 20% of the economic activity in the archipelago [7, 8]. I.V. Rogachev and S.I. Shubin study the role of the universities of Russia and Norway in the Barents Euro-Arctic region, the beginning of cooperation started formally more than 25 years ago, but in fact — several centuries ago thanks to “people's diplomacy” [9]. N.N. Schmidt, T.R. Christiansen and T. Roslin review two decades of collaborative research and environmental monitoring at the remote Zackenberg research facility in high-altitude Greenland. The article shows that “the combination of monitoring ideas with a mechanistic understanding obtained as a result of fundamental research, gave the most complete understanding of the system for the benefit of all and as an example to follow ...” [10, p. 652]. I. Zashihina and M. Postnikova analyze “the social consequences that determine the use of mass media in modern education. The peculiarities of the post-industrial society call for a rethinking of the professional competencies taught in all types of curricula. Students get the opportunity to use a rich assortment of media that are widely used by most teachers today as a source of education...”. The authors point to “the dependence of participants in modern education on their understanding of the mechanism and influence of the media” [11, p. 612].

### ***Features of Denmark's research activities in the Arctic***

Denmark published the Arctic Research and Education Strategy in 2016, which sets the framework for the Ministry of Higher Education, the government body responsible for scientific research organization. The organizational and financial potential of ministries, departments and business interested in R&D (in particular, the National Research Fund, the Innovation Fund) is used.

The objectives of Danish scientific research in the Arctic region are the following: development of education and research in Greenland, participation in the coordination of education and research in the Arctic for the rational exploitation of natural resources, dissemination of research results in the Arctic within the framework of international cooperation, positioning Denmark as a partner, supporting the research environment <sup>10</sup>.

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<sup>10</sup> Co-operation in the Arctic Science — Challenges and Joint Actions. Report of the 2nd Arctic Science Ministerial, 25-26 October 2018, Berlin, Germany, p. 38.

The research topics are derived from the country's strategic interests in the Arctic region: sustainable development of the Arctic and Greenland, study of methods for the search and development of minerals and the extraction of aquatic biological resources, study of sea currents, marine and terrestrial glaciology, paleoclimatology, climate change and the impact of these processes on indigenous communities in Greenland and the Faroe Islands (social and health aspects), monitoring of environmental pollution. Universities that are able to organize and conduct research in the Arctic region include the Universities of Copenhagen, Aarhus, Aalborg and the Technical University of Denmark. They have established interdisciplinary scientific and consulting centers for the environmental and socio-economic development of Greenland and foreign Arctic territories.

The University of Copenhagen was founded in 1479. There are currently about 40 thousand students in 6 faculties: medical, humanitarian, juristic, scientific, social sciences and theological. The university has the Center for Permafrost and the Center for Ice and Climate, which are engaged in research on the geographic and physical effects of permafrost condition and degradation, study of ice cores in Greenland, and also participate in the development of innovative technologies for paleoclimatic and paleoecological reconstructions of the glacial and interglacial periods <sup>11</sup>.

The Aarhus University has more than 44 thousand students studying humanities and natural sciences: pedagogical, physical, mathematical, statistical sciences, ecology, environmental management, art, journalism, business, and law <sup>12</sup>. The Aarhus University participates in thematic networks of the University of the Arctic on the study of microplastic pollution in the Arctic Ocean, the study of tundra biodiversity in the context of climate change, social and medical aspects of human well-being, sustainable production of natural products in the North. The university conducts applied research in the field of improving the quality of environmental management and sustainable development, marine ice and icebergs studies (models of underwater robots are being developed).

The Aalborg University's specialization in the UArctic network is sustainable use of natural resources and social responsibility. Approximately 20 thousand students are trained in the fields of tourism, biotechnology, water resources management, environmental quality preservation, energy, technological design, and urban planning in the North <sup>13</sup>.

The Technical University of Denmark has about 10 thousand students. Its educational programs include aspects of territorial planning, architectural design in the Arctic, environmental studies and protection (including waste management), and mining. Research in the field of infrastructure development, energy efficiency, climate change is carried out at the Center for Arctic Technologies

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<sup>11</sup> The University of Copenhagen. URL: <https://www.ku.dk/english/> (accessed 10 May 2020).

<sup>12</sup> The Aarhus University. URL: <https://www.au.dk/> (accessed 10 May 2020).

<sup>13</sup> The Aalborg University. URL: <https://www.en.aau.dk/> (accessed 10 May 2020).

<sup>14</sup> The Technical University of Denmark. URL: <https://www.dtu.dk/english> (accessed 10 May 2020).



Higher education in the Faroe Islands is represented by the University in Tórshavn<sup>15</sup>. It was founded in 2008 as a result of merger of the Faroese School of Education, the Faroese School of Nursing and the University of the Faroe Islands. The university has around 1000 students. Its educational and research specialization is in the fields of local linguistics and literature, oceanography (the study of sea tides and currents)<sup>16</sup>. The university specializes in coastal communities, fisheries and aquaculture, northern tourism, folklore and ethnography of the Arctic.

Greenland has a university in Nuuk<sup>17</sup>. It was founded in 1987 and has over 200 students. The university has a humanitarian focus and consists of the institutes of education, nursing and medicine, social sciences, economics and journalism, culture, language and history. The Greenland Institute of Natural Resources (GINR) has about 20 students. GINR conducts comprehensive studies of Arctic ecosystems, monitors climate change (a priority) and environmental changes, and advises local authorities on sustainable environmental management. Research is focused on marine ecology, productivity of aquatic biological resources, biogeochemical and ice processes, Arctic medicine, extraction and use of mineral resources. The university's specialization at the University of the Arctic is sustainable development of coastal communities, usage of natural resources and social responsibility, global environmental and economic challenges in the Arctic and Subarctic.

For scientific research purposes, Danish universities use multifunctional ice-class research vessels (Denmark, like other foreign Arctic states, does not have nuclear icebreakers). Research stations in Greenland are of great importance in collecting data on the state of the Arctic ecosystems, climate change trends, the state of the Greenland ice sheet, its permafrost, natural, social and medical aspects of life of the Eskimos: Zakenberg in the northeast, the Disko Island station in the central parts of West Greenland, Vilnum (Nord) in North Greenland, Sermilik near the Sermil Fjord. Danish universities participate in international Arctic research programs. Access to research stations in Greenland for foreign specialists is opened by a project funded by the EU Horizon 2020 program (The EU Framework Program for Research and Innovation) INTERACT, which is a network of 90 bases in Northern Europe, Russia, the USA, Canada, Greenland, Iceland and Faroe Islands<sup>18</sup>. The UArctic Denmark finding program (within the UArctic Education north2north program) is used to provide financial and organizational support to young Danish researchers at universities in the Arctic countries and foreign students at universities in Denmark, Greenland and the Faroe Islands<sup>19</sup>.

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<sup>15</sup>University of the Faroe Islands. URL: [https://en.wikipedia.org/wiki/University\\_of\\_the\\_Faroe\\_Islands](https://en.wikipedia.org/wiki/University_of_the_Faroe_Islands) (accessed 10 May 2020).

<sup>16</sup>Co-operation in the Arctic Science — Challenges and Joint Actions. Report of the 2nd Arctic Science Ministerial, 25-26 October 2018, Berlin, Germany, p. 42.

<sup>17</sup>University of Greenland. URL: [https://www.unipage.net/ru/6563/university\\_of\\_greenland](https://www.unipage.net/ru/6563/university_of_greenland) (accessed 10 May 2020).

<sup>18</sup>EC Horizon 2020. URL: <https://ec.europa.eu/programmes/horizon2020/en> (accessed 10 May 2020).

<sup>19</sup>UArctic Denmark finding. URL: <https://education.uarctic.org/mobility/about-north2north/> (accessed 10 May 2020).

### *Features of Iceland's research activities in the Arctic*

The content and tools of Iceland's research activities in the Arctic region are derived from the provisions of the 2011 Parliamentary Resolution on the Arctic and correspond to Iceland's status as an island state, a member of the Arctic Council.

The non-governmental Icelandic Arctic Cooperation Network (IACN) plays the leading role in information support and coordination of research activities of government agencies, scientific and educational institutions and businesses on Arctic issues. Its activities are coordinated by The Icelandic Joint Committee on Arctic Affairs, under the Ministry of the Environment and Natural Resources. Both structures include universities and research institutions. Almost all of them, when compiling research topics, take into account the peculiarities of Iceland's geographic location, give priority attention to marine management issues and the development of alternative energy. Unlike Norway and Sweden, Iceland does not have grant programs to support Arctic research<sup>20</sup>.

The University of Iceland is the largest university in the country with over 13 thousand students of all levels of education. It consists of the following schools: social sciences, health care, humanitarian, pedagogical, natural sciences and technology. Scientific research is carried out in research centers and field stations<sup>21</sup>. The University of Reykjavik has about 3 thousand students in schools of business, computer science, law, science and technology<sup>22</sup>. The University of Akureyri is a research and educational center in North Iceland, offering educational programs in the humanitarian sphere: business, sciences, health, as well as scientific services from seven research centers<sup>23</sup>. The Arctic topics of the university are represented by the topics of Arctic law, sociological study of the attitude of Icelandic youth to climate change and the formation of values in the industrial and rural areas of the North of the country. The Agricultural University of Iceland was founded in 2005. It consists of the Faculty of Land and Animal Resources, the Faculty of Environmental Sciences; scientific topics are focused around climate change in the Arctic region, the creation of the northern gene bank of agricultural plants and animals<sup>24</sup>. Bifröst University consists of departments of business, law, social sciences. About 700 students study here<sup>25</sup>. The University Center of the Westfjords operates in collaboration with other universities and research institutions, specializing in sea and coastal management issues. Hólar University College exists since 2007, the first educational institution in this place was established in the XII century. Aquaculture, marine biology, fisheries management and rural tourism are taught there<sup>26</sup>. The Institute of Marine Research is one of the leading scientific centers in the country and, taking into account the geographical location and economic specialization of the country, plays a vital role in the scientific potential of

<sup>20</sup> Co-operation in the Arctic Science — Challenges and Joint Actions. Report of the 2nd Arctic Science Ministerial, 25-26 October 2018, Berlin, Germany, p. 52.

<sup>21</sup> The University of Iceland. URL: [https://english.hi.is/university/study\\_information](https://english.hi.is/university/study_information) (accessed 10 May 2020).

<sup>22</sup> The University of Reykjavik. URL: <https://en.ru.is/> (accessed 10 May 2020).

<sup>23</sup> The University of Akureyri. URL: <https://www.unak.is/english> (accessed 10 May 2020).

<sup>24</sup> The Agricultural University of Iceland. URL: <https://ru.wikipedia.org/wiki/> (accessed 10 May 2020).

<sup>25</sup> Bifröst University. URL: <https://www.bifrost.is/> (accessed 10 May 2020).

<sup>26</sup> Hólar University College. URL: <http://www.holar.is/en/english> (accessed 10 May 2020).

Iceland. The institute specializes in the study of the sea and aquatic biological resources, provides information and analytical support for government activities, and provides business services.

Stefansson Arctic Institute is Iceland's leading research institution located in Akureyri under the Ministry of Environment and Natural Resources. This institution takes an interdisciplinary approach to understanding the relationship between human and environment in the circumpolar Arctic. Special attention is paid to the socio-economic research and assessments of the Arctic, human development trends (the Human Development Report 2010–2014), management of marine resources, ecology of agricultural systems, climate change and adaptation to them (incl. in the context of cryosphere degradation). The institute is a basement for functioning of the Arctic Council secretariats (working groups Conservation of the Arctic flora and fauna and Protection of the Arctic marine environment), the Icelandic Arctic Cooperation Network, since 2017 — the secretariat of the International Arctic Scientific Committee <sup>27</sup>.

Iceland uses the capabilities of research stations Grimsfjall Glaciological Society, located in the center of the Vatnajökull glacier and intended for geophysical research, including subglacial volcanoes. Litla-Skard Station is a national site (biomonitoring site) for the implementation of an international air pollution monitoring program. The research focuses on precipitation chemistry, climate change and hydrological features of ecosystems. This station is used by the Agricultural University of Iceland. The automated meteorological and hydrological stations of the Icelandic Meteorological Office operate here <sup>28</sup>.

### *Features of Norway's research activities in the Arctic*

The Norwegian Strategy for the Development of the Northern Regions was first approved in 2006 and updated in 2017. In order to implement the Strategy, Norway is implementing a scientific and educational policy aimed at achieving sustainable development in the northern regions. Interdisciplinary research is organized for this purpose, aimed at obtaining new knowledge and developing competencies in the field of researching the environment, population and economy of the Far North. A feature of the Norwegian Arctic research policy is its sustainable funding. The priority projects are PETROMAKS (program of research in the field of oil and gas and the development of innovative scientific infrastructure), BARENTS 2020 (program of international interdisciplinary educational and scientific projects on Arctic topics, academic and research mobility with the participation of Russia), programs for development and exchange knowledge about the climate system of the Far North POLARPROG and KLIMAFORSK, support of R&D in the field of maritime activities (in the interests of shipping companies, fishing, aquaculture, industry) MAROFF. The Nansen Legacy project is being implemented in 2018–2023, and is aimed at studying the Arctic Ocean and polar ecosystems in the face of climate change. Institute of Marine Research of the Barents Sea and Ecosystems of the Arctic Ocean in partnership with the Nikolai M. Knipovich Polar

<sup>27</sup> Stefansson Arctic Institute. URL: <http://www.svs.is/en/projects/ahdr-and-asi-secretariat> (accessed 10 May 2020).

<sup>28</sup> Co-operation in the Arctic Science — Challenges and Joint Actions. Report of the 2nd Arctic Science Ministerial, 25-26 October 2018, Berlin, Germany, p. 52.

Research Institute of Marine Fisheries and Oceanography (Murmansk) monitors the reserves of aquatic biological resources and marine ecosystems in the Barents Sea <sup>29</sup>.

The Norwegian Polar Research, Research Policy 2014–2023 Strategy defines a list of research areas in the Arctic: international research cooperation (strengthening the role of the Barents Euro-Arctic Council (BEAC) and the Arctic Council in solving the problems of the Arctic), climate change and the impact on environmental management (among indigenous peoples, changes in the hydrometeorological features of the Far North), functioning of polar ecosystems, environmental monitoring in industrial development areas, development of research infrastructure, dissemination of research results <sup>30</sup>.

Government agencies, research centers and universities are responsible for the implementation of Norway's R&D strategy. The area of interest of the Fram Center (High North Research Center for Climate and Environment, Research Center for Climate and Environment in the Far North) is the study of climate, ice, sea, the impact of industry and pollution on ecosystems <sup>31</sup>. The center is subordinated to the Ministry of Nature and Environment and coordinates the activities of organizations involved in Arctic research (Institute of Marine Research, National Coastal Administration, Meteorological Service, Cartographic Service, Geological Survey, Akvaplan Niva Company). Research by the Norwegian Polar Institute covers climatology, glaciology, geophysics, biodiversity. The Institute uses the ice-class ships "Kronprins Haakon" (an Italian-built vessel, commissioned in 2018) and "Helmer Hanssen" (a highly specialized vessel designed for studying marine ecosystems, assessing the reserves of aquatic biological resources), as well as the capabilities of the scientific center on Svalbard. The Norwegian Centre for International Cooperation in Education (SIU) <sup>32</sup> is a subordinate institution of the Norwegian Ministry of Education and Science. SIU administers programs aimed at developing international educational cooperation in the Arctic region, for example, the High North Program. This program supports projects of academic and research mobility, development of joint courses, educational schools between universities in Norway, Russia, Canada, USA, Japan, China, Republic of Korea.

The main educational center and organizer of scientific research in the Far North of Norway is the University of Tromsø — The Arctic University of Norway <sup>33</sup>. More than 16 thousand students study and more than 3.6 thousand employees work here, funding reaches 4 million NOK per year. UiT educational programs and research cover fundamental and applied aspects from international relations, economics, applied mathematics, culture, sports, to polar meteorology, organic and macromolecular chemistry, linguistics, polar medicine, underwater geology of the Arctic Ocean,

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<sup>29</sup> Norwegian Research Council. URL: <https://www.forskningsradet.no/en/> (accessed 10 May 2020)

<sup>30</sup> Co-operation in the Arctic Science — Challenges and Joint Actions. Report of the 2nd Arctic Science Ministerial, 25–26 October 2018, Berlin, Germany, p. 62.

<sup>31</sup> Fram Center. URL: <https://framsenteret.no/> (accessed 10 May 2020).

<sup>32</sup> The Norwegian Centre for International Cooperation in Education. URL: <http://siu.no/> (accessed 10 May 2020).

<sup>33</sup> University of Tromsø — The Arctic University of Norway. URL: <https://uit.no/startside> (accessed 10 May 2020).

mining, industrial environmental monitoring, remote sensing of the Earth, the study of climate change, the study of the Sami.

Nord University was established in 2016 on the basis of the Nordland University in Bodø, the capital of the Nordland province<sup>34</sup>. About 11 thousand students study at the university, about 1.3 thousand people work there. The university provides training in the faculties of business, biological sciences (including in the field of genomics) and aquaculture, health sciences, social sciences, education and art. The University's development strategy identifies the priority areas of research: "blue" and "green" growth, sustainable development, innovation, entrepreneurship and health, welfare and education.

The Sami University College is located in Kautokeino. It has about 270 students and 110 employees. The college includes departments of crafts, reindeer husbandry, natural and social sciences, languages, journalism. The College is one of the leading institutions in Northern Europe for research on the use of natural resources, languages, culture and the rights of indigenous peoples.

On the Svalbard archipelago there is the northernmost scientific and educational University Center in Longyearbyen in Norway and in the world<sup>35</sup>. The center was founded in 1993 and is the result of collaboration between the universities of Oslo, Bergen, Tromsø and the Norwegian University of Engineering and Natural Sciences. It has about 690 students, at least 50% of them are foreign students. The center is characterized by the application-oriented study of the Arctic in the fields of biology, geology, geophysics. The center is the base for organizing and conducting field work in the archipelago, including international participation. The Center for Arctic Security has been created on the basis of the Center, a master's program and practical safety courses for industry and researchers have been developed.

### ***Features of Finland's research activities in the Arctic***

Finland's research policy in the Arctic region, as in neighboring Sweden, is shaped in specific geographic conditions. Despite the fact that both countries do not have direct access to the Arctic Ocean and only a third of their territories are located beyond the Arctic Circle, in 2011–2013 they published Arctic strategies in which both states declared their entire territory Arctic. Finland and Sweden position their activities from an expert perspective, declare their readiness to be involved in projects for the study and development of natural resources, environmental protection, climate studies, environmental management of indigenous peoples, infrastructure development (including navigation in the Arctic Ocean), the economy of the Far North, and share advanced developments with neighbors. Finland and Sweden declare the possibility of producing innovative technology and science-intensive equipment that is ready to operate in the harsh conditions of the Far North and the Arctic (drilling platforms, icebreakers, reinforced ice-class vessels, satellite surveil-

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<sup>34</sup> Nord University. URL: <https://www.nord.no/en/about/> (accessed 10 May 2020).

<sup>35</sup> University Center in Svalbard. URL: <https://www.unis.no/> (accessed 10 May 2020).



lance) and to test advanced research methods demanded in the extreme conditions of the North and the Arctic<sup>36</sup>.

In 2016, the National Arctic strategy was modernized. In 2017, an action plan for its implementation in four areas was developed: Arctic country, Arctic competence, sustainable development and rational use of natural resources, international cooperation. The Finnish feature of the Arctic policy is the increased attention to international cooperation in the North. Finland was a founding member of the Arctic Council in 1996, the EU Northern Dimension program (a union of more than 30 universities and research organizations in the fields of environmental protection, health and social development, transport, logistics and culture), BEAR working groups on education, transport and logistics, including the NSR. Rovaniemi hosts the EU Arctic Information Center.

Responsibility for the preparation and implementation of the Arctic research program based on the Arctic strategy is rested on the National Committee for Arctic and Antarctic Research and the Academy of Finland, a government agency subordinate to the Ministry of Education and Culture<sup>37</sup>. In order to achieve the best results of research activities, it is envisaged to use public-private partnerships, including participation of Russian enterprises (Team Finland concept)<sup>38</sup>. The Finnish Meteorological Institute (FMI) participates in scientific research in the Arctic region, where space exploration is carried out with the support of the North American Aerospace Agency and the European Space Agency. The Satellite Data Collection Center in Sodankylä developed and tested a solar sail, probes for the study of Mars, comet 67P/Churyumov-Gerasimenko in outer space in 2014–2015. The Institute uses the capabilities of the Pallas-Sodankylä field station for observing the atmosphere and the global cryosphere<sup>39</sup>.

In order to implement the country's Arctic policy, universities and other organizations in Finland avail of the possibilities of scientific expedition activities using the ship "Aranda", which belongs to the Finnish Environment Institute<sup>40</sup>. A unique feature of the Finnish experience in the study of sea ice is the ice basin models owned by Aalto University and Finnish private companies. They conduct experimental studies of the design and behavior of ships and marine structures on a model scale, study ice destruction, develop innovative Arctic technologies<sup>41</sup>.

More than 5 thousand students study at the University of Lapland<sup>42</sup>. In scientific research, the educational institution specializes in environmental studies, geology, the population of the Arctic region, law, geopolitics, ethnography, art, design, as well as the Sami. The Arctic Center with international participation studies the behavior of glaciers, the impact of climate change on eco-

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<sup>36</sup> Co-operation in the Arctic Science — Challenges and Joint Actions. Report of the 2nd Arctic Science Ministerial, 25–26 October 2018, Berlin, Germany, p. 44.

<sup>37</sup> Academy of Finland. URL: <https://www.aka.fi/en> (accessed 10 May 2020).

<sup>38</sup> Team Finland concept. URL: <https://www.team-finland.fi/en/team-finland-organisations/> (accessed 10 May 2020).

<sup>39</sup> Finnish Meteorological Institute. URL: <https://en.ilmatieteenlaitos.fi/> (accessed 11 May 2020).

<sup>40</sup> Finnish Environment Institute. URL: <https://www.syke.fi/en-US> (accessed 11 May 2020).

<sup>41</sup> Report of the 2nd Arctic Science Ministerial Cooperation in Arctic Science — Challenges and Joint actions. Germany, Berlin, 25–26 October 2018, Bonn. 2018. 116 p.

<sup>42</sup> University of Lapland. URL: <https://www.ulapland.fi/InEnglish/About-us> (accessed 11 May 2020).

conomic activities, the environment and the population of the Arctic region. The study of the natural resources use by the Sami, aspects of their environmental law is allocated in a separate direction. The UArctic Secretariat is located at the University of Lapland. Scientists work in more than 50 thematic networks: extractive industries, natural resources, law, sustainable development, design, folklore, geopolitics, social responsibility, public health and well-being, tourism, teacher education, management of small and medium-sized enterprises.

Aalto University has about 12 thousand students and more than 4 thousand employees. The university consists of the following schools: business, engineering, chemical engineering, electrical engineering, sciences, art, design and architecture. The university specializes in the study of Arctic ice, snow cover, permafrost, their degradation under the influence of climate change and the impact on infrastructure, prevention of damage to structures<sup>43</sup>.

The University of Helsinki was founded in 1640; about 40 thousand students study here and 8 thousand employees work in 11 faculties. Key research topics are digital world, aging and health, globalization and sustainable development, life sciences, the human mind in a changing world, materials science. In the Arctic, the university specializes in biology, ecology, climatology, geology, geography and physics research. In 2018, the Institute for Sustainable Technologies was established, which is an inter-faculty unit in the field of sustainable development (including the study of the "Arctic" aspects of this concept). The university cooperates with the Helsinki Institute of Urban and Regional Studies, participates in making programs for territorial development, urban design and urban planning. The university has the Kilpisjärvi Biological Station for field research on biological and ecological topics, as well as the history of the Sami and Lapland. At the Värri Research Station, owned by the Institute for Atmospheric Research, the focus is on ecosystems, as well as atmospheric processes and air pollution in the Arctic.

The University of Oulu is the leading university in Finland. It has 16.5 thousand students and about 3 thousand employees<sup>44</sup>. The university works in eight areas: humanities, education, economics, natural sciences, technology and architecture, healthcare. The scientific strategy of the university includes several sections: sustainable use of natural resources, molecular and ecological basis of health, digitalization, remote study of environmental changes, global changes and their impact on humans. The Arctic research of the university includes the use of natural resources, sustainable technologies for their extraction, atmospheric chemistry, technologies suitable for extreme conditions, Arctic logistics, and public health in the northern regions. The university has scientific centers for the study of the Sami language, folklore and history. The Oulanka Station of the University of Oulu allows year-round studies of the Arctic environment, primarily in the areas of geography, biology, ecology, meteorology and weather forecasting. Most of the research activities are concentrated in the Oulanka National Park. Cooperation within the UArctic is carried out on the following topics: Arctic geology, engineering, natural resources and social responsibility, peda-

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<sup>43</sup> Aalto University. URL: <https://www.aalto.fi/en/aalto-university> (accessed 11 May 2020).

<sup>44</sup> University of Oulu. URL: <https://www oulu.fi/university/> (accessed 11 May 2020).

gological sciences, telecommunications and networks, commercialization of science and technology for the needs of the North, health and well-being of the population, indigenous peoples, northern tourism, food security. The University of Turku organizes biological, natural-geographic and environmental science research in the natural and social sciences at the Kevo Subarctic Research Station in Lapland, the northernmost in the EU.

### *Features of Sweden's research activities in the Arctic*

According to the Sweden's Arctic strategy (2011), only a third of the territory is located near and beyond the Arctic Circle: the Norrbotten and Västerbotten regions, which are part of the BEAR.

The content of Sweden's research policy in the Arctic region, in addition to the Arctic strategy, is also formulated in road maps, programs "Swedish National Polar Research Programs: 2014 and beyond", "Priority Projects of Swedish Arctic and Antarctic Research Programs". Priority attention is paid to research in the field of climate change and environmental assessment (such aspects as biogeochemical parameters of the Arctic Ocean, distribution of heavy metals, study of ecosystems, glaciers, geomorphology of the Arctic Ocean bottom)<sup>45</sup>.

The Swedish Polar Research Secretariat is a specialized agency under the Ministry of Education and Science. The Secretariat organizes and supports research expeditions in polar regions and manages research infrastructure (icebreaker Oden, research station Abisko)<sup>46</sup>. The Secretariat works in cooperation with the Swedish Research Council<sup>47</sup>. The Swedish Institute is a government agency that maintains interest in Sweden. Possibilities of information policy, organization of Swedish language courses abroad, as well as academic and research mobility in the Baltic Sea region and in the North of the country are used for this purpose. The main form of project support is grants, scholarships, information promotion in the media<sup>48</sup>. The Swedish Foundation for International Cooperation in Research and Higher Education (STINT)<sup>49</sup> promotes internationalization as a tool to improve the quality of research and higher education, increase the competitiveness of universities, and enhance the attractiveness of Swedish universities.

One of the demanded tools of the country's research activities, participating in the collection of data on marine ecosystems, biogeochemistry of waters and geomorphology of the seabed of the Arctic Ocean, meteorological conditions of the Far North and the Arctic, is the multifunctional diesel icebreaker Oden, built in 1988, a participant of international expeditions, an important means of demonstrating geopolitical aspirations of Sweden in the Arctic.

Umeå University is the largest educational institution in Västerbotten. It consists of the Faculty of Medicine, the Faculty of Art, the Faculty of Social Sciences, the Faculty of Science and

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<sup>45</sup> Co-operation in the Arctic Science — Challenges and Joint Actions. Report of the 2nd Arctic Science Ministerial, 25-26 October 2018, Berlin, Germany, p. 76.

<sup>46</sup> Swedish Polar Research Secretariat. URL: <http://www.polar.se/> (accessed 11 May 2020).

<sup>47</sup> Swedish Research Council. URL: <https://www.vr.se/english.html> (accessed 11 May 2020).

<sup>48</sup> Swedish Institute. URL: <https://si.se/en/about-si/our-mission/> (accessed 11 May 2020).

<sup>49</sup> Swedish Foundation STINT. URL: [http://www.stint.se/en/stint/about\\_stint](http://www.stint.se/en/stint/about_stint) (accessed 11 May 2020).

Technology, the Faculty of Medicine, where 42 international programs are implemented, more than 35 thousand students study, more than 2 thousand employees work. The University's Arctic Research Center conducts scientific research related to the socio-economic and cultural development of the northern regions of Sweden <sup>50</sup>.

More than 15 thousand students study and about 1.7 thousand people work at the Luleå University of Technology <sup>51</sup>. The university consists of the departments of business administration, engineering technology, electronics, space exploration, social sciences, sustainable development, transport and communications, education, health care, construction, environmental protection, renewable energy, computer science, mathematics. The university is the main one for training highly qualified personnel to work at the Kiruna polar mine, the largest in Europe, where one of the world's highest-quality iron ore deposits is mined.

Norrbotten is home to the Abisko research station, which was founded in 1912 to study the climate <sup>52</sup>. The station is the venue for the Summer and Winter student scientific and educational schools. There are several laboratories at the station: chemical, geoecology/soil, instrumental and microscopy, isotopic, lake science, bacteriological.

The Tarfala Research Station <sup>53</sup> is operated by Stockholm University, highlighting the fact that it is not only northern universities that are involved in studying climate change and its impact on the environment and the natural resources management. This station has been monitoring climate change since 1910, implementing international training programs for studying and predicting long-term connectivity between climate and weather. The scientific research program includes monitoring the climate impact on the subarctic nature, including the mass balance of glaciers, as well as snow, their hydrology, assessment of the state of permafrost.

### **Conclusion**

Having studied the participation of Northern European universities in the implementation of the research policy of these states in the Arctic region, we can conclude that all states consider the Arctic as a dynamically changing region. Its transformations in the natural and socio-economic environment necessitate organization and conducting of interdisciplinary scientific research. The most comprehensive and thoughtful research activities in the Arctic are presented in Norwegian and Finnish universities. Research topics in all countries of the region are identical and include aspects of natural, socio-political, socio-economic sciences and areas of training: from a priority for all Nordic countries (from natural resources to infrastructure and logistics) development of northern regions, improvement of environmental management, study of shipping in the Arctic Ocean, climate change, analysis and development of innovative approaches to environmental protection,

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<sup>50</sup> Umeå University. URL: <https://www.umu.se/en/> (accessed 11 May 2020).

<sup>51</sup> Luleå University of Technology. URL: <https://www.ltu.se/> (accessed 11 May 2020).

<sup>52</sup> Abisko research station. URL: <https://polar.se/en/research-in-abisko/> (accessed 11 May 2020).

<sup>53</sup> Tarfala research station. URL: <https://www.natgeo.su.se/english/tarfala-research-station> (accessed 11 May 2020).

protection of indigenous peoples, participation in energy and infrastructure (e.g. information and communication technology) projects..

The governments of the northern countries pay special attention to scientific and educational cooperation, supporting academic and research mobility, exchange of knowledge on working in the extreme conditions of the Far North and the Arctic. Effective protection of the population and nature in the Far North, search and updating of knowledge, organization of scientific research are possible within the framework of international cooperation with the participation of the Nordic states. The Nordic countries were at the origin of the Arctic programs of the EU, BEAR and the Arctic Council. Therefore, in the Arctic strategies, they focus on international cooperation with participation of state, business, NCOs, research organizations. Iceland, Finland and Sweden position themselves as experts who have the best practices for living in the Far North, which they are ready to share with their neighbors. The Nordic countries are characterized by a policy of internationalization, attracting the maximum number of participants to study and solve problems in the region, including countries from outside Europe and the Far North, and always with the participation of Russia. The results of scientific activities of the Nordic countries are used to support innovation and technology policies and geopolitical aspirations of the Nordic countries and are at the core of global sustainable development.

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