Science Diplomacy in the polar regions

The polar regions are the epicenter of climate change: twelve of sixteen identified tipping points are located in the two regions. These include, for example, thawing permafrost, the melting Greenland ice sheet, and the sea ice of the Arctic Ocean[1]. The Arctic is warming up to four times as fast as the rest of the planet. This is not only affecting the polar regions but worldwide[2]. To understand such global phenomena, internationally coordinated research is essential. The findings of this research can subsequently be used on the international political stage as a basis for devising solutions. Science thus plays an increasingly important role in international relations against the backdrop of growing global challenges and a closely interconnected world.

After the start of the Russian war of aggression against Ukraine on February 24, 2022, scientific cooperation with representatives of the Russian Federation (Russia) was frozen. Western researchers thus have little access to the Russian Arctic anymore, which accounts for about 40% of the Arctic land area. From a scientific perspective, this lack of data represents a massive limitation to further research on climate change. International cooperation between the West and Russia in Arctic research has been a mainstay of "Arctic exceptionalism" since the end of the Cold War. The concept has been used to describe peaceful and cooperative international relations in the Arctic insulated from global geopolitics[3]. Arctic exceptionalism has lost much of its validity with the start of the Russian war of aggression against Ukraine[4]. The Russian war of aggression is also having an impact in Antarctica, although less strong than in the Arctic (see below). Against the backdrop of climate change and increased geopolitical tensions[5], the question arises as to what role science diplomacy can play in the future of cooperation in the Arctic.

Science diplomacy

The concept of science diplomacy is still quite young. It emerged in the first decade of the 21st century. However, the phenomenon that the concept describes is much older[6,7]. Science diplomacy is not uniformly defined but generally describes the use of science and scientific knowledge to advance diplomatic interests. Common features of the various definitions are the recurring aspects of "common challenges and interests," the improvement of relations between states (beyond scientific cooperation), and the use of "alternative channels of communication"[6–9]. The term "science diplomacy" is not limited to natural science but includes other fields like social science. The most common definition was developed in 2009 by the American Society for the Advancement of Science (AAAS) and the British Royal Society. It divides science diplomacy into three dimensions[7,8,10]:

Science in Diplomacy describes the importance of scientific knowledge in political decision-making processes. Given growing global challenges such as climate change, which require global responses, these are becoming increasingly relevant. A well-known example is the Intergovernmental Panel on Climate Change (IPCC), whose reports provide a scientific basis for action on climate change. Additionally, scientific findings can serve as a neutral basis in diplomatic processes. This "neutral language" of science can be particularly beneficial in otherwise difficult diplomatic relations between states and on critical issues such as security. One example is disarmament treaties, in which researchers can be neutral observers[10].

When bilateral or multilateral agreements are concluded at the political level to promote scientific cooperation, one speaks of Diplomacy for Science. On the one hand, such agreements can be concluded for economic interests, such as sharing costs and risks for cost-intensive research infrastructure. This applies, for example, to cost-intensive research on nuclear fusion. On the other hand, such agreements can also promote individual contact between researchers by reducing restrictions, such as visa facilitation, and promoting joint international research projects[10].

In the **Science for Diplomacy** dimension, scientific collaboration improves overall relations between states. Joint research has the potential to build trust and improve connections between societies through personal contacts among researchers. Science is also referred to as a "bridge builder" in this context. The European Organization for Nuclear Research (CERN) is a good example. This institution was founded a few years after the end of World War II to re-establish links between European countries (including the Eastern Bloc). Another example is the International Space Station (ISS)[10].

The three dimensions are usually not clearly separable from each other, so there are many cases where dimensions overlap or follow each other in time. In the case of CERN, for example, agreements at the diplomatic level were first necessary before cooperation could begin, which in turn improved relations between the states[10]. Another important aspect of international research cooperation, which is important in all dimensions, is the standardization of research methods to facilitate the comparison and further processing of data.

Science Diplomacy in the history of polar research

Scientific cooperation across national borders has a long history in polar research. However, the beginning was marked by **competing expeditions**. These expeditions - first in the Arctic, later also in the Antarctic - were often about making sovereignty claims to the newly discovered areas[11]. An example is the "race" to the South Pole between the Briton Scott and the Norwegian Amundsen, which the Norwegian won in 1911[12]. These discoveries are still justifications for territorial claims in Antarctica today, which are, however, dormant under the Antarctic Treaty (see below)[13].

In the mid-19th century, there were the first attempts at international scientific cooperation in the Arctic. These were motivated by common interests in better understanding the influence that the polar regions have on weather - and thus agriculture and food security - in more southerly regions[14]. These efforts, driven by Georg von Neumayer and Karl Weyprecht, among others, resulted in the **1st International Polar Year** (IPY-1) in 1882-83. During IPY-1, joint international expeditions were conducted for the first time to collect and analyze data in a uniform manner. The first IPY-1 demonstrated for the first time the benefits of international cooperation in polar research and created an institutional memory that was the catalyst for further international Arctic expeditions and the Second International Polar Year 1932-33[15,16].

Institutional memory also survived World War II and was of great importance for the rapid implementation of the Third International Polar Year 1957-58 (renamed the International Geophysical Year - IGY). Despite tensions during the Cold War, 67 nations from both blocs participated in the effort, including the United States of America (USA) and the Soviet Union (USSR). Because of the political environment, the planning and evaluation of the IGY were left to neutral international organizations - the World Meteorological Organization (WMO) and the International Council of Scientific Unions (ICSU). The IGY was the largest scientific undertaking in human history and produced some lasting achievements[15,16]. On a global level, these were the ICSU World Data Centers. They are geographically and politically globally distributed archives for the collection of scientific data. They were originally used to collect the results of the IGY[15,17]. In Antarctica, scientific collaboration during IGY also provided a template for the development of the Antarctic Treaty[18]. The Scientific Committee on Antarctic Research (SCAR), founded in 1958 to continue the scientific work of the IGY in Antarctica, is still the most important international scientific body in Antarctica today (see below)[16].

International agreements on environmental protection

Science diplomacy - especially the dimension "science in diplomacy" - has already been instrumental in the development of significant environmental protection agreements in the past, three of which are now presented as examples:

The **Agreement on the Conservation of Polar Bears** was concluded in 1973, in the middle of the Cold War, between the USA, Canada, the USSR, Norway, and the Kingdom of Denmark (Greenland). In the agreement - the first environmental protection agreement between East and West[19] – the countries agreed to undertake coordinated efforts to protect the polar bears, which at that time were endangered, primarily by hunting. The agreement was preceded by internationally coordinated scientific research, the findings of which served as the basis for the agreement. On the 40th anniversary of the agreement in 2013, the signatories reaffirmed the importance of the latest scientific findings ("best available science") in the development of measures[20,21].

EU science diplomacy

Science diplomacy plays an increasing role for the institutions of the European Union (EU) in their foreign policy, as shown, among other things, by official documents[27,28] or the initiative of the EU Science Diplomacy Alliance[29]. In addition, the European Commission is developing the first EU strategy on science diplomacy, to be published at the end of 2023[30]. Science is also used as a diplomatic tool in the Arctic, where the EU is a major player due to its member states Finland, Sweden, Denmark, and various other interests[31]. On the other hand, the EU also uses international research cooperation as an instrument of soft power (exertion of influence), among other things, for the dissemination of European values and the pursuit of EU interests, and ties the awarding of research funds to non-EU states to conditions[34]. In its decisions, the EU also identifies risks of scientific cooperation, such as foreign influence and unwanted knowledge transfer. Therefore, the EU prioritizes cooperation with so-called "like-minded partners" to protect its strategic autonomy[27,28,35].

The **Montreal Protocol**, signed in 1987 to regulate ozone-depleting substances such as chlorofluorocarbons (CFCs), is considered a milestone of international scientific cooperation and of science as an instrument in diplomatic processes. Research on the ozone layer has long been the subject of international research cooperation. During the IGY, the foundation was laid for the Global Ozone Observation System, which also maintains stations in Antarctica. In 1974, researchers first raised concerns that CFCs could harm the atmosphere. At the time, CFCs were considered a "miracle cure" and were found in many everyday products. These concerns were further investigated by the United Nations Environment Program (UNEP). In the early 1980s, holes in the ozone layer were first identified, particularly over Antarctica. In the years that followed, the U.S. government became involved on the international stage in what became known as "ozone diplomacy" to regulate CFCs, resulting in the Montreal Protocol in 1987. In addition to scientific findings, many other interests of various actors played a role in the process. Among other things, the availability of alternatives to CFCs was crucial. Today, it is assumed that the atmosphere could recover[22].

In 2018, the **Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean** (CAOF Agreement) was signed by the five Arctic Ocean coastal states and major fishing nations, among others. The agreement is characterized by its precautionary nature: It prohibits commercial fishing in the Central Arctic Ocean until sufficient scientific knowledge on fish stocks and their possible regulation is available[23,24]. The agreement is an example of successful "diplomacy for science" and "science in diplomacy"[25,26].

The Antarctic Treaty

The Antarctic Treaty is one of the most frequently cited examples of science diplomacy[10,16]. The 1959 treaty made the continent a nature reserve dedicated to peace and research and a common heritage of humankind[36]. Previously, Antarctica was a region of overlapping territorial claims. In addition, the Cold War arms race also increased the danger that military infrastructure could be built and nuclear tests conducted on the continent. The assertion of territorial claims and the entry into an arms race in Antarctica would have been associated with very high costs for the states involved. The interest on all sides was thus to prevent possible geopolitical conflicts in Antarctica from flaring up in the first place. The success of the IGY 1957-58 in facilitating international, cross-bloc scientific cooperation in a politically very tense environment served as a template and incentive for the Antarctic Treaty. The IGY is thus a fitting example of how scientific cooperation can lead to political cooperation[10,16,18]. The treaty was signed in 1959 by the twelve states

that were scientifically active in Antarctica during the IGY, including all states that had previously made territorial claims in Antarctica, as well as the USA and the USSR. Since then, 44 other states have signed the treaty (including the German Democratic Republic (GDR) in 1974, the Federal Republic of Germany (FRG) in 1979, and also Ukraine in 1992)[37]. The treaty provides that Antarctica, including the waters south of 60°S, may only be used for peaceful purposes in the interests of humankind. The expansion and continuation of scientific cooperation along the lines of the IGY is a fundamental part of the treaty. Using the continent for military purposes, testing nuclear weapons, and disposing of radioactive waste is prohibited - which at the same time made the Antarctic Treaty the first arms control treaty[16]. The territorial claims made until 1959 were frozen by the treaty; the making of new claims is prohibited[10,38]. Today, scientific research, fishing, and a growing tourism are the only activities in Antarctica[39].

The central governance instrument of the Antarctic Treaty is the **Antarctic Treaty Consultative Meetings** (ATCM). At the ATCMs, the current 29 Consultative Parties make decisions by consensus. Consultative Parties are all those of the 44 signatory states of the Antarctic Treaty that are "substantially"[38] engaged in scientific activities in Antarctica[37,40]. The **Scientific Committee on Antarctic Research** (SCAR), which coordinates the research programs of individual nations, represents science in the ATCMs [41]. SCAR attends ATCM meetings as an observer and supports the decision-making process through scientific reports produced at the request of the ATCM (Science in Diplomacy)[42].

Within the framework of the Antarctic Treaty, numerous other agreements for protecting Antarctica have emerged that were not included in the original treaty. These agreements and the Antarctic Treaty merge to form the Antarctic Treaty System (ATS)[40]. Among them is the **Convention on the Conservation of Antarctic Marine Living Resources** (CAMLR Convention), which entered into force in 1982[39]. The agreement aims to improve the protection and sustainable use of Antarctic krill and fish stocks. To this end, science-based decisions and measures have been taken based on the precautionary principle, similar to the case of the CAOF Agreement (see above) in the Arctic. CAMLR is also responsible for the designation of **marine protected areas** (MPAs) where, among other things, commercial fishing is prohibited. The designation of such protected areas is also a process that is decided at the political level but is preceded by extensive scientific studies as a basis for data[43].

After six years of negotiation, the Convention on the Regulation of the Exploration and Utilization of Antarctic Mineral Resources (CRAMRA) was adopted in 1988 but was never ratified by any state[44]. In a remarkable about-face, the international community instead decided on a moratorium on commercial exploration and extraction of Antarctic mineral resources, enshrined in the 1991 Protocol on Environmental Protection to the Antarctic Treaty (also called the **Madrid Protocol**)[39,45]. To date, 42 of the 44 signatory states to the Antarctic Treaty have acceded to the Madrid Protocol, which entered into force in 1998. The treaty is still considered one of

Signing ceremony of the Antarctic Treaty on 1st December 1959 (Photo: Herman Phleger/ATS image Bank)

the most comprehensive multilateral environmental protection treaties, and current environmental protection agreements are still based on it (e.g., in the case of the UN Convention on the Protection of High Seas Biodiversity - BBNJ Agreement).

The Protocol also established a Scientific Commission to advise the signatories to the Antarctic Treaty on the implementation of the Protocol[39]. The agreement has a provisional term of 50 years and can be revised in 2048 if all member states agree[45].

Arctic Council

The Arctic Council is a high-level international forum that promotes cooperation among Arctic states. In addition to the member states - the eight Arctic states - six representative organizations of the Indigenous Peoples of the Arctic are represented on the Council as Permanent Participants[54]. In addition, numerous governmental and non-governmental actors are represented as observers in the Arctic Council, participating in particular in the work of the Council's

six working groups (see Fact Sheet "Arctic Council")[55]. These working groups are scientific bodies that provide information on behalf of the Arctic Council on various topics that form the basis for the Council's decisions[56-58]. The strong involvement of Indigenous representative organizations is a unique feature of the Arctic Council. The inclusion of Indigenous knowledge is also a way for Indigenous Peoples to make their voices heard on the political stage[58]. The initial spark for cooperation in the Arctic came from a speech by Mikhail Gorbachev in Murmansk in 1987. Before that, the Arctic had been highly relevant strategically during the Cold War - initially, nuclear bomber and nuclear missile flight paths passed over the Arctic; later in the Cold War, the region was primarily characterized by submarine operations - and heavily militarized, especially on the Soviet side. In the speech, also called the Murmansk Initiative, Gorbachev called for disarmament and cooperation in the Arctic. Specifically, in the speech, he proposed establishing an "Arctic Research Council" to promote scientific cooperation and an agreement between the northern European states for better environmental protection in the Arctic[59,60]. In 1990, the first proposal gave rise to the International Arctic Science Committee (IASC). Implementation of the second proposal was driven from a Finnish initiative, also known as the "Rovaniemi Process," and resulted in the establishment of the Arctic Environmental Protection Strategy (AEPS) in 1991. On the initiative of the Canadian government - which sought to broaden the mandate to include greater Indigenous involvement and sustainable development - the Arctic Council was established in 1996 on the basis of the AEPS[60-63]. The Arctic Council is thus the result of diplomatic engagement that has enabled and facilitated scientific cooperation58. For 25 years since its inception, the Arctic Council and its working groups have contributed significantly to the resilience of circumpolar cooperation against global geopolitics (Arctic exceptionalism)[3]. The close ties between the Arctic states, including in research, made it possible for Arctic exceptionalism to survive the Russian annexation of Crimea in 2014[64].

Voting rights in the Arctic Council are reserved only for the eight Arctic states (member states). **Arctic Council observers** are thus limited in their ability to influence Arctic governance. A prerequisite for observer status, similar to the ATS, is scientific engagement in the region that is regularly monitored. This structure allows member states to control the activities of non-Arctic states and thus maintain the exclusivity of the Arctic. Thus, scientific engagement is one of the few ways for observers to demonstrate and legitimize their presence and interests in the Arctic. Accordingly, science as a diplomatic tool plays a major role in the Arctic strategies of observer states[33,65,66]. A prominent example here is China, which - against the backdrop of its global power ambitions, which are also evident in the Arctic - is using, among other things, high levels of scientific engagement in the region to legitimize increasing presence and interests in the region[67].

Under the auspices of the Arctic Council, three legally binding agreements have been concluded in the past (see the fact sheet "Governance in the Arctic"[68]).

Science Diplomacy in German Polar Research

The Federal Republic of Germany (Germany) is a very committed international player in polar research. The Alfred Wegener Institute (AWI), founded in 1980, and the research icebreaker Polarstern play a key role in this[46,47]. Examples of polar research include the Neumayer Station in Antarctica[48], the German-French AWIPEV research base in Ny-Ålesund (Svalbard) founded in 2003[49] or the particularly high-profile MOSAiC Expedition 2019-20, which involved researchers from 20 countries[50]. These efforts in polar research, which in their beginnings in the 1980s were motivated by resource interests, among other things, also secured Germany a political say. Thus, in 1981 (the GDR in 1987[51]), the Federal Republic of Germany attained the status of a consultative state in the ATCM[37], and in 1998, observer status in the Arctic Council[52]. The German government provides financial support for German research projects and advocates expanding bilateral and multilateral research cooperation on the political stage[47]. Conducting its own research ensures Germany's independence from knowledge imports from other countries. The accumulated knowledge plays an important role in informed decision-making processes, including in international negotiations. In addition, international cooperation in Arctic research contributes to improving relations with Arctic states. Involvement - including in Arctic Council working groups - has made Germany a respected and well-regarded player among Arctic Council observers, thus securing some influence for Germany in Arctic governance. Research cooperation is also used to establish and maintain cooperative relations with other states while avoiding hard security issues[47,53]. An example of this was the cooperation with Russia before the Russian war of aggression against Ukraine started.

Among them is the **Agreement on Enhancing International Arctic Scientific Cooperation**, signed in 2017. The agreement includes visa facilitation and sharing infrastructure and data, among other things, and is thus another example of "diplomacy for science"[69]. Although this agreement has not yet had a major impact on the day-to-day activities of researchers, it demonstrates the importance of scientific cooperation and findings for policy cooperation in the Arctic[70,71].

German-Russian cooperation

A glance at the map shows the importance of Russia for Arctic research. Almost half of the Arctic territory is Russian territory. Especially with regard to permafrost research, Russia is of great importance due to the concentration of permafrost in Siberia. Russia was also an important partner for German research in the Arctic for a long time[46]. For example, researchers from the AWI and their Russian and other German partners have been using the Samoylov station in the Siberian Lena delta since 1998 and have conducted permafrost research there, among other things[75,76]. The MOSAiC expedition of the German icebreaker Polarstern would also not have been possible without Russian partners and icebreakers' expertise and logistical support. This cooperation has been promoted at the ministry level through various agreements. For example, the German Federal Ministry of Education and Research (BMBF) and its Russian counterpart signed the WTZ (Scientific Technical Cooperation) agreement in 2009, which was intended to promote scientific cooperation by breaking down barriers[77]. Such agreements are important for implementing joint research projects, as they often form the basis for further, more specific agreements, and researchers can refer to them in approval processes. In addition to this bilateral framework, cooperation between Russian and German researchers has also occurred within multilateral institutions such as IASC and the working groups of the Arctic Council. In addition to institutionalized cooperation, close relationships between researchers have formed over the past decades since the end of the Cold War. These close personal ties are the last form of scientific cooperation to be maintained after the beginning of the Russian invasion of Ukraine and the subsequent breakdown of scientific relations.

Independently of the Arctic Council, another forum focuses on international research cooperation in the Arctic and can be classified in the dimension "Diplomacy for Science." The **Arctic Science Ministerial Meeting** (ASM) has been held every two years since 2016. The conferences are attended by ministers responsible for science and research from all countries that conduct Arctic research. In contrast to the Arctic Council, all states (whether the Arctic or not) are equal and have voting rights. In addition to these, the EU, Indigenous representative organizations, and other non-governmental organizations also take part[72-74].

The Russian War of Aggression against Ukraine

After the start of the Russian war of aggression against Ukraine on February 24, 2022, official scientific cooperation with Russia was largely suspended at the institutional level by Western states as a result of sanctions. Russian state-funded institutions were excluded from ongoing projects, and their financial support was stopped. The German Federal Ministry for Education and Research (BMBF) has also put projects with Russian participation on hold[4]. However, scientific cooperation between Western democracies and Russia continues to take place in isolated instances. The U.S. and Russia, for example, continue to cooperate within the framework of the ISS.

These measures have far-reaching implications for polar research. Because of the conditions on the ground, it can be carried out largely only through cooperation, which includes the institutional level. Scientific projects involving Russian state institutions were frozen from one day to the next. The cooperation freeze means that a lot of data from Russia is no longer available, which due to the size of the Russian Arctic, is irreplaceable to understanding the changes in the region as well as the global impact. In contrast, individual exchanges with Russian researchers, who are considered part of civil society, continue to some extent and include joint publication of research results, depending on national and institution-specific regulations. However, due to the repression of civil society in Russia (e.g., the law on "foreign agents "[78]), communication with Russian researchers is only possible with restrictions and may involve risks for the Russian researchers. This is especially true for those who openly position themselves against the Russian war of aggression against Ukraine[4,79-81].

The consequences of Russia's war of aggression also represent a turning point in the Arctic. Many scientific organizations have suspended or limited their cooperation with Russian actors in response to

Foreign Ministers of the eight Arctic states and heads of the six Permanent Participants of the Arctic Council (Photo: Icelandic Ministry for Foreign Affairs/Gunnar Vigfússon)

the Russian invasion of Ukraine. At the political level, the seven Western Arctic states have suspended their work in the Arctic Council, which was under Russian presidency at the time[82]. Since June 2022, after it became foreseeable that the war would continue, work in the Council's working groups has continued on a limited basis to the extent possible with the exclusion of Russian actors[83]. Official representatives of Western countries also stayed away from the Arctic Science Ministerial Conference held in Russia in April 2023[74]. The Arctic Council and the Arctic Science Ministerial Conference show that the concept of "Arctic exceptionalism" has limits and that the Arctic is no longer isolated from political events in the world[33]. Arctic exceptionalism shows, both in its emergence and in its demise, how dependent science is on politics[84].

On the other hand, the Russian war of aggression against Ukraine had less of an impact on the ATCM's work in Antarctica. ATCM meetings continued to be held after the invasion with the participation of Western and Russian representatives. One explanation is that this is due to the ATCM's treaty framework and the small role - compared to the Arctic Council - played by Russia as one of 29 consultative parties[85]. The same phenomenon can be observed in other treaty-based organizations, such as the United Nations. In all United Nations organizations, Russia and Western states continue to sit at the same table[86]. However, the war in Ukraine has direct implications for scientific cooperation in Antarctica. As in the Arctic, there is no longer any official scientific cooperation between Western and Russian researchers. German researchers, for example, can no longer rely on a Russian-operated flight network, which until now was an important logistical building block for the operation of the German Neumayer Station III. The work of the ATCM is rather influenced by a global trend towards more national thinking, which had already become apparent before the start of the Russian war of aggression against Ukraine. Common interests and scientific knowledge, as well as positive spillover effects into policy, thus seem to be losing importance in the face of increased geopolitical tensions between Western democracies and authoritarian systems such as Russia and China. Also, the consensus process in the ATS and scientific evidence is increasingly needed to pursue national interests. Scientific findings are increasingly questioned or ignored in negotiations. An example of this is the designation of marine protected areas (see above), which have been blocked by individual member states since 2016, among other things, because they consider protection measures to be a potential threat to future interests in Antarctica[43].

Outlook

In the face of common challenges and geopolitical tensions, the question arises as to what role science and science diplomacy can play in the future. After the notion of "science diplomacy" gained much popularity since the early 2000s and may have been overstated as an important tool for resolving political conflicts and common challenges[87,88], the start of Russia's

Scientists conducting joint field experiments during the MOSAiC Expedition (Photo: AWI/Stefan Hendricks)

war of aggression against Ukraine and its aftermath have put the effectiveness of the concept to a stress test. After the start of the Russian war of aggression against Ukraine, a diplomatic component of scientific cooperation could again be observed. However, in this case, cooperation was not promoted, but rather it was restricted due to the cooperation freeze, which also affects science and research. The impact basis of the "science for diplomacy" dimension was thus significantly impaired[89]. The cooperation stop shows that scientific findings are only one among many factors in political decision-making processes[90].

There is no foreseeable "back to normal" in Arctic research cooperation as seen before the war. This is probably the only point of consensus in the research community. On the other hand, whether, when, and under what conditions a resumption of cooperation with Russia can take place is controversially discussed. An end to hostilities in Ukraine is often cited as a precondition for a resumption of cooperation. Others, however, presuppose a fundamental change in Russian policy[79]. Neither is to be expected in the foreseeable future[33,80,91]. However, even if these conditions were to be met in the future and a resumption of scientific cooperation was possible, it is questionable whether it would be continued. This is due, on the one hand, to the tensions between Western democracies and authoritarian systems such as Russia and China, which had already risen before the start of the Russian war of aggression and which increasingly regard international cooperation as undesirable interference from outside and want to control it more tightly. In the Arctic, the growing tensions in recent years have manifested themselves, among other things, in the increasing militarization of the region. For Russia, the Arctic has become the most important military-economic key region[92]. This has also led to a loss of trust between the Arctic states.

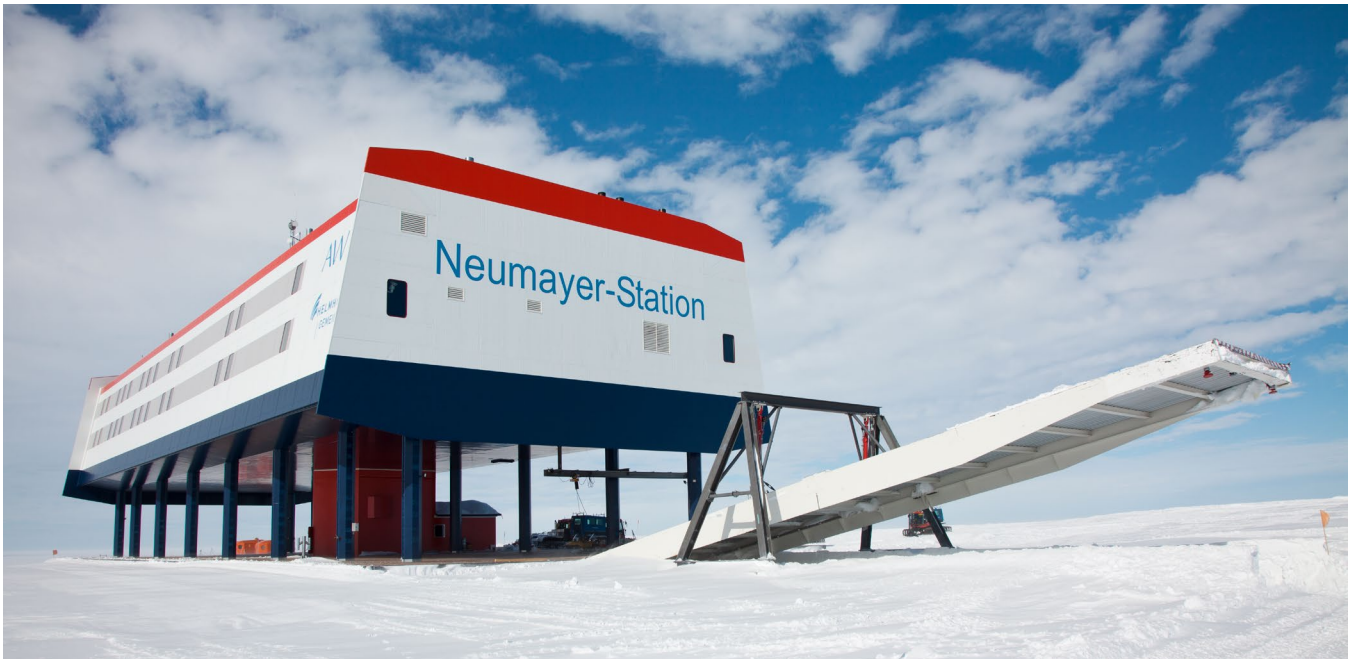
Further, changes in Russia's Arctic strategy raise doubts about the interest in future scientific cooperation. The updated version of the strategy devalues the importance of multilateral cooperation and emphasizes stronger bilateral cooperation based on Russian "national interests." This change will likely have consequences for the importance of the Arctic Council (a multilateral intergovernmental forum) to Russia[93]. In the updated version of Russia's Arctic strategy, measures against climate change and environmental protection lose importance. Instead, the importance of economic and security interests is emphasized[94]. Also, as the current situation continues, it will become increasingly difficult to revive scientific cooperation with Russia. Institutions such as the Arctic Council and its working groups are losing visibility and importance in their current limited form[95]. Personal contacts that have been built

up over three decades and are currently maintained - also in the hope that they could serve as a basis for a resumption of scientific cooperation in the future - threaten to erode over time. This last effect is intensified by the fact that young researchers are denied the opportunity to form networks as a result of the Russian war of aggression against Ukraine and the repression of Russian civil society[78,79,84,96].

These factors weaken the potential of scientific cooperation as a diplomatic tool. Militarization of the region further increases tensions and reduces access to the region for researchers[97]. Moreover, due to its often dual-use nature (e.g., oceanography), research becomes a potentially sensitive area. It may, therefore, even arouse distrust in other states[98]. The low importance of climate and environmental protection in the current Russian Arctic strategy also reduces the importance of climate and environmental research, although this is of the highest importance in the Arctic at the international level. Common problems thus remain[96,99], while common solutions are no longer in the common interest. Researchers from both sides are meanwhile switching to other partners and regions[78]. German permafrost research, for example, is shifting its focus to Alaska and northern Canada. New technical solutions are also being considered to obtain data from the Russian Arctic, especially via satellite observation[4]. Russia, in turn, would like to increase research cooperation with the BRICS countries (Brazil, Russia,India, China, and South Africa) - especially with China[100,101]. This cooperation is also to be seen as a strengthening of the bilateral cooperation Russia is striving for and, therefore, aims to improve relations with these countries (science for diplomacy), as they have become much more important for Russia, which is isolated from the West[101]. The increasing political bloc formation is thus also increasingly reflected in science[102] and makes it difficult to resume cooperation as it existed before the Russian war of aggression began. The conditions for using science as a diplomatic instrument to improve relations with Russia are, therefore, not very favorable at present.

For the Arctic Council, the handover of the chairmanship of the Arctic Council from Russia to Norway will be crucial in the short term. Great hope is placed in the Norwegian chairmanship to continue the activities in the Arctic Council, also because Norway has shown much skill in dealing with Russia in the past[103] However, it remains to be seen how exactly the Arctic Council will be continued since Russia cannot be excluded from the Council, but cooperation between the Western Arctic states and Russia is currently also excluded. This future of the Arctic Council could also be important for the long-term perspective of cooperation in the Arctic. If the Arctic Council does not remain in existence, this could strengthen the role of non-Arctic states.

Given past successes, the next (fifth) International Polar Year 2032-33, preparations for which are already underway, may offer a perspective - albeit a very long-term one - for a resumption of international scientific cooperation with Russian stakeholders[104].



The German Neumayer Station III in the Antarctic (Photo: AWI/Thomas Steuer)

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