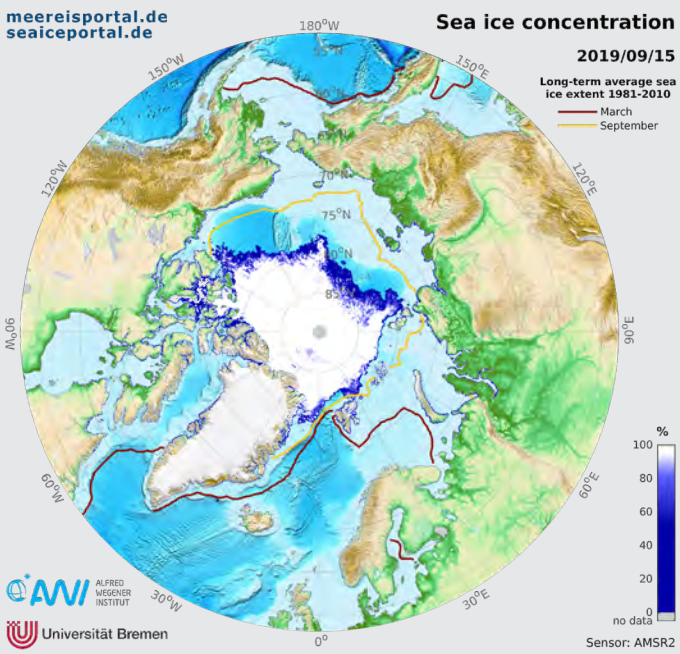
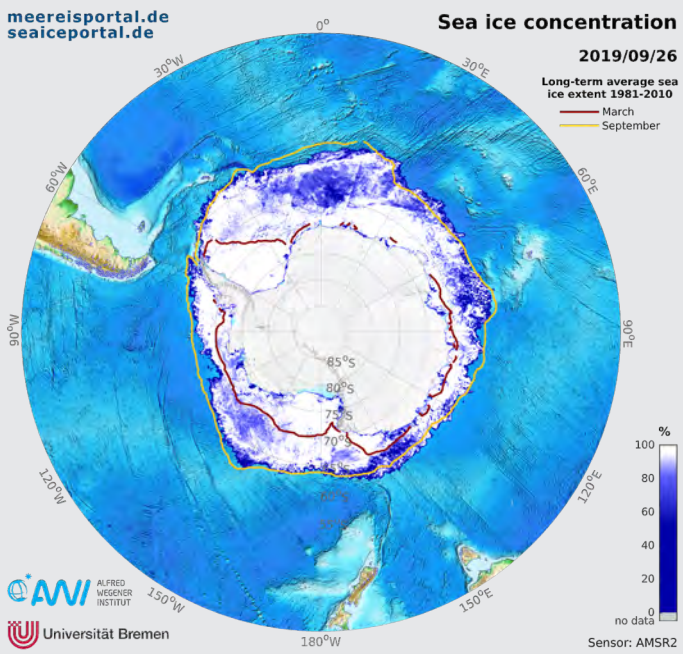
FACT SHEET





OUR CURRENT KNOWLEDGE OF:

Arctic and Antarctic - more differences than similarities?

Globalisation and climate change have accompanied the development of the world in recent decades. The polar regions are also affected by climate change as well as by the internationalisation of politics and economy. In the following, a brief summary of the development of the two polar regions is given, and differences and similarities are presented.

What is the geopolitical framework of the polar regions?

The forms of political control mechanisms in the polar regions experienced a considerable surge in development in the 20th century[1]. While the regulatory framework in the South Polar region was established by the Antarctic Treaty of 1959, the North Polar region, as one of the hotspots of global warming, faces more complex political power constellations[1,2]. The melting of sea ice in Arctic waters provides new shipping routes and access to previously untapped mineral, oil and gas resources. Thus, climate change is bringing the Arctic into the focus of geostrategic interests of state actors. The importance of the Arctic is reflected, for example, in the activities of the Russian Federation in its Exclusive Economic Zone (EEZ)[3,4]. In March 2020, the Russian State Duma adopted economic objectives in the Arctic region aimed at industrialisation and use of natural resources. China, too, is focusing its national interests on the Arctic region, is conducting negotiations with Russia on the development of a Polar Silk Road, and hopes that the investment will bring economic benefits[5].

Figure above: map of minimum sea ice extent in the Arctic 15 September 2019 (left). For the sake of comparison, the respective long-term averages for the Arctic minimum sea ice extent in September (yellow) and the Arctic maximum sea ice extent in March (red) are also depicted. Map of maximum sea ice extent in the Antarctic 26 September 2919 (right). For the sake of comparison, the respective long-term averages for the Antarctic minimum sea ice extent in March (red) and the Antarctic maximum sea ice extent in September (yellow) are also depicted. Source: seaiceportal.de

Sea ice in the Arctic. (Photo: Stefan Hendricks/AWI)

The United Nations Convention on the Law of the Sea (UNCLOS) provides the legal basis for the resolution of territorial issues in the Arctic region and for the use of Arctic waters. The Convention, signed in 1982, is a multilateral treaty and entered into force on 16 November 1994[1,6]. To date, 167 countries have ratified the treaty, but so far not the USA. UNCLOS divides the oceans, including Arctic waters, into different marine zones in which riparian countries may exercise certain sovereign rights to a defined extent.

The Arctic Council is the main intergovernmental forum for the Arctic. It comprises the eight riparian countries: Canada, the Kingdom of Denmark, Finland, Iceland, Norway, the Russian Federation, Sweden and the United States of America. The representative organisations of the indigenous peoples are Permanent Participants. Non-riparian countries, governmental and non-governmental organisations may apply for observer status[1]. Historically, the creation of the Arctic Council can be traced back to, among other things, the 1987 Murmansk speech by Mikhail Gorbachev. His vision was that the Arctic region should be maintained as a zone of peace for humanity (more information in the fact sheets "Arctic Governance" and "Arctic Council")[7].

The legal framework for political activities of state and non-state actors in the Southern Ocean region is laid down by the Antarctic Treaty. The Treaty was signed on 1 December 1959 by Argentina, Australia, Belgium, Chile, France, Great Britain, Japan, New Zealand, Norway, South Africa, the Soviet Union and the United States of America and entered into force on 23 June 1961[7,6]. Germany is now a member of the Convention with 54 other member countries. Under this treaty, the Antarctic and the marine areas south of 60 degrees latitude are reserved exclusively for peaceful use and international cooperation, especially in the field of scientific research. All military activities and the disposal of radioactive waste are prohibited, and the assertion of national territorial claims is prohibited. Historically, the signing of the Antarctic Treaty dates back to the International Geophysical Year from 1957 to 1958[7]. The cooperation between various countries in Antarctic research drove state actors to develop institutional arrangements for international political governance in the Southern Ocean region. The result was the establishment of the Scientific Committee for Antarctic Research (SCAR), which promotes research in the Antarctic region. Its Arctic counterpart, the International Arctic Science Committee (IASC), was founded in 1990.

How relevant are the polar regions for security policy?

The north polar region is a subject of international politics and is of great importance in terms of security policy. The role of the Arctic in international security policy can be traced in historical events: During World War II, the Norwegian town of Narvik was the scene of battles for hegemony in the North Atlantic[8]. The security policy dimension retained its relevance beyond the Second World War and was characterised by a bipolar order between the USA and the Soviet Union. The Arctic, as the shortest link between the USA and the Soviet Union, played a strategically important role in the deterrence tactics of the two powers during the Cold War. The Russian Kola Peninsula was the stationing base for about 25 per cent of the Soviet nuclear arsenal, while the USA expanded military bases in Greenland in the 1960s[8]. After the end of the East-West conflict, the significance of the Arctic shifted from a security policy arena to a place of multilateral cooperation[9]. To date, there is no multilateral body explicitly dealing with security policy in the Arctic. Although the risk of military conflict in the Arctic is low, climate change in the region poses potential risks of conflict[10].

In contrast, the Antarctic Treaty prevented the militarisation of Antarctica. In the mutual inspections anchored and regulated there, strict attention is paid to ensuring that no military activities take place at national Antarctic stations and infrastructures[7].

What is the situation of the Arctic indigenous peoples?

The north polar region remains a central living space for indigenous peoples to this day. North of the Arctic Circle there is a population of about 400,000 indigenous people, consisting of more than 30 different ethnic groups. Due to their settlement history going back thousands of years and their cultural identity in the Arctic, the indigenous peoples are of great political importance. In the Arctic Council, the indigenous peoples organisations enjoy a special status as Permanent Participants[1,11,9].

„I look with scepticism at the polar region as a separate part of the political order. In my opinion, the Arctic is a part of the international system that is influenced by three factors: the political system level, the geographical conditions and the development of technology"

Dr Rasmus Gjedssø Bertelsen / UiT The Arctic University of Norway. (Photo: Michael Morreau)

Which socio-economic aspects are important in the polar regions?

At the beginning of the 21st century, our world is shaped by the complex interdependencies of a globalised economy. In view of climate change, this also applies to the polar regions. Both the northern and southern polar regions are targets of commercial interests of state actors and global corporations. According to estimates by the United States Geological Survey (USGS), 22 per cent of the as yet undiscovered oil and gas deposits are located north of the Arctic Circle[6,12].

New opportunities for access to Arctic resources mean that the north polar region is increasingly attracting the attention of the riparian countries. The Russian Federation, Norway and Canada are investing heavily in the development of the technical infrastructure for the extraction of raw material deposits[5]. In addition, due to potential environmental impacts on polar ecosystems in the Arctic, companies are increasingly coming under public scrutiny, which is why oil and gas drilling projects are often withdrawn.

In addition to easier access to raw materials in Arctic waters, climate change due to the melting of sea ice is making new shipping routes possible: the Northwest Passage along the Canadian coastal waters as well as the Northeast Passage along the Siberian Arctic coast[13]. Navigation of Arctic sea passages is subject to a number of legal requirements, which are known as the Polar Code for navigation in polar waters (more information in the factsheet "Shipping in the Arctic")[6].

Furthermore, climate change opens up opportunities for commercial fishing in the Arctic region. For some years now, marine biologists have been observing that fish are increasingly migrating from the Atlantic or Pacific to the north due to ocean warming. In December 2017, the EU, the Arctic coastal states, China, Japan and South Korea signed a legally binding agreement prohibiting commercial fishing beyond the "Exclusive Economic Zones" of the Arctic states[14]. First of all, scientific studies should provide clarity about the effects of fishing in the Arctic Ocean.

In economic terms, the Southern Polar region differs significantly from the Arctic. In the 18th and 19th centuries, whales and seals were hunted intensively until stocks declined to the point where commercial use was no longer worthwhile. In order to prevent further overexploitation of nature, separate international agreements were adopted under the umbrella of the Antarctic Treaty. To protect Antarctic seals, the Convention for the Conservation of Antarctic seals was adopted in 1972. The conservation of Antarctic marine living resources is regulated by the "Convention on the Conservation of Antarctic Marine Living Resources", founded in 1980, under which fishing quotas for krill and fish stocks are established[6]. The International Whaling Commission adopted a moratorium on commercial whaling in 1987 and established whale sanctuaries in the Indian Ocean and the Southern Ocean. The Convention on the Regulation of Antarctic Mineral Resource Activities (CRAMRA) was negotiated in the 1980s for the exploitation and exhaustion of Antarctic mineral resources[6]. However, no country signed this Convention - instead, the international community of states made a dramatic change of direction and in 1991 adopted a special environmental protection protocol to the Antarctic Treaty, which entered into force in 1998. The Protocol contains the most comprehensive environmental protection regulations ever drawn up for a region of the world in an international convention and is therefore still groundbreaking today. It has so far been ratified by 41 countries that have committed themselves to keeping the Antarctic as a nature reserve dedicated to peace and science and to protecting the Antarctic as such for future generations. In addition to research, fishing (e.g. for krill) and tourism are permitted in the area covered by the Antarctic Treaty to a regulated extent[6]. However, the Protocol

Ministerial Conference of the Arctic Council in Kiruna, Mai 2013. (Photo: Volker Rachold)

on Environmental Protection prohibits any activity involving mineral resources (with the exception of scientific research). The Environmental Protocol remains in force until 2048 and can be renegotiated thereafter[7].

What legal regulations apply to the establishment of protected areas in the Antarctic?

The term Marine Protected Area (MPA) is used to describe marine nature protection zones for the preservation of the natural environment in the respective area. The Commission for the Conservation of Antarctic Living Marine Resources (CCAMLR), which is part of the Antarctic Treaty System and currently has 26 members, is responsible for creating and designating areas to protect the fragile and unique biodiversity and ecosystems of the Southern Ocean[15,16].

In 2009 CCAMLR adopted the world's first high seas conservation area in international waters south of the South Orkney Islands. This was followed in 2016 by the adoption of an MPA in the Antarctic Ross Sea, which at over 1.5 million km^2 is one of the largest MPAs in the world[12]. Unfortunately, the necessary unanimous adoption of further MPAs, such as the MPA proposal for the Weddell Sea prepared by German scientists, has been increasingly hampered in recent years by a divergence of interests among CCAMLR members. While many members consider MPAs to be an important means of protecting the environment and improving the management of anthropogenic activities, other members see these MPAs as a threat to their efforts to intensify the economic exploitation of Antarctic resources, particularly fisheries.

In addition to MPAs, CCAMLR also allows localities where vulnerable marine ecosystems (VMEs) have been found to be closed to bottom fishing on a small scale. In addition, there are a number of Antarctic Specially Protected Areas (ASPA) and Antarctic Specially Managed Areas (ASMA) established under the Antarctic Treaty, which include not only land areas but also small, coastal marine areas[17].

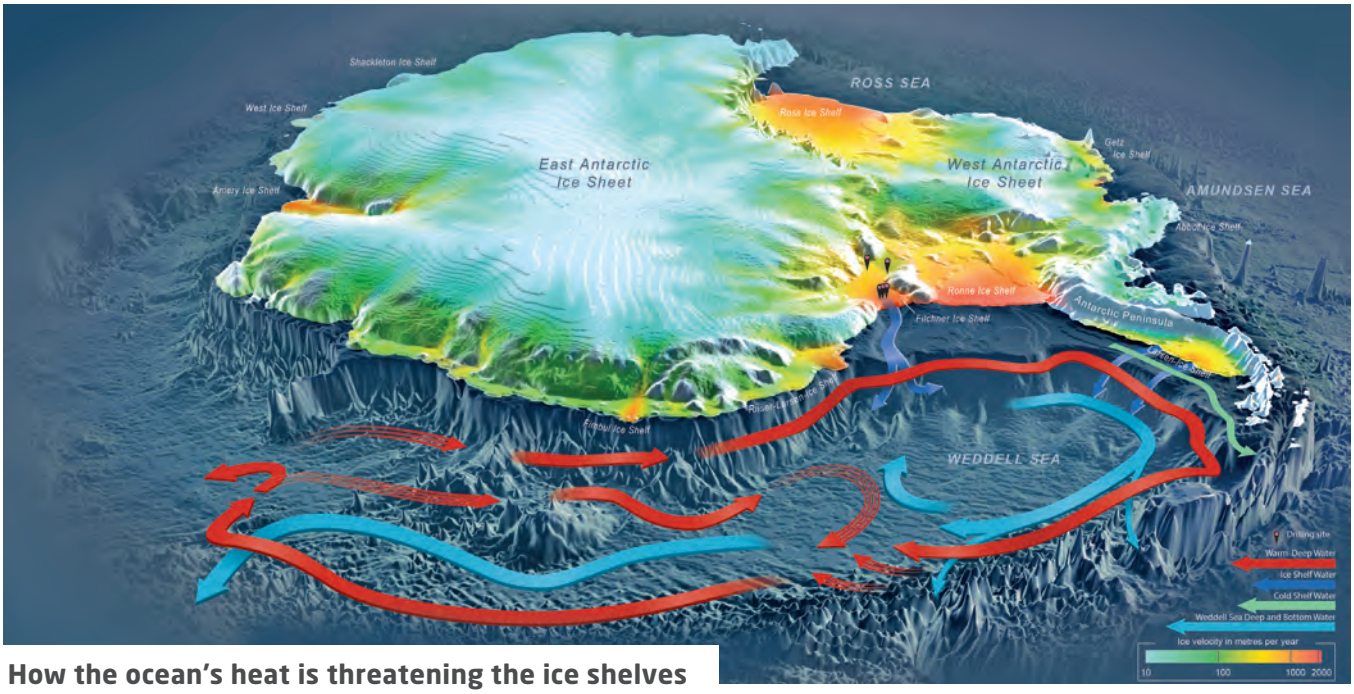
Why is the Arctic warming faster than the Antarctic?

The polar regions of the Earth are characterised by a negative radiation and corresponding heat balance on an annual average, which means they are predominantly covered by snow and ice. However, in recent decades, the Arctic has warmed up about twice as fast as the rest of the Earth; a phenomenon known as "Arctic amplification"[23].

This is due, among other things, to so-called feedback processes such as the ice-albedo feedback, which is set in motion, for example, by the retreat of Arctic sea ice. The relatively thin, snow-covered sea ice in the Arctic is present all year round. Due to its bright surface and high albedo, it reflects about 90 per cent of the incident sunlight.

Overview table for characterisation of the Arctic and Antarctic

	Arctic	Antarctic
Commonality of the regions	Are located between the north or south pole and the corresponding polar circle	
Area description	Intercontinental ocean bounded by the continents of America, Europe and Asia[18].	Central polar continent surrounded by the southern ring ocean[19].
Polar Circle	Latitude 66° 33' N; defined as the latitude at which the sun does not set for 24 hours on the summer solstice[19].	66° 33' southern latitude; defined by the latitude at which the sun is completely hidden behind the horizon for 24 hours on the winter solstice[19].
Riparian countries/environment	Canada, Kingdom of Denmark (Greenland), Finland, Iceland, Norway, Russian Federation, Sweden and the United States of America	Ring ocean
Annual average temperature (land surface)[19]	-18°C	-49.3°C
Maximum thickness/ expansion of the ice sheets[19]	3,200 m / 1.71 Mio. km^2	4,897 m /11.9 Mio. km^2 (without ice shelves)
Sea ice	Perennial, 2 m average thickness[20]	One year old, 0.5 to 0.6 m average thickness[20]
Population	approx. 4 million people, of which approx. 10 % are indigenous[21]	Not inhabited; temporary settlement by 1,000 - 4,000 scientists at 85 research stations[22]
Flora & Fauna[19]	21,500 known animal and plant species About 5 % of the vascular plant species are endemic. On land: 14,000 In water: 7,600 Examples: Polar bears, polar foxes Herbs, mosses, lichens	12,230 known animal and plant species High proportion of endemic animal and plant species. On land: 1,600 In water: 10,630 Examples: Penguins, seals, whales Mainly flowerless plants (mosses, lichens, algae)



How the ocean's heat is threatening the ice shelves

The Antarctic Ice Sheet does not completely rest on solid ground. At the coast, it forms permanent floating sheets of ice, which are still connected to the landmass and cover ten thousands of square kilometres. These giant floating ice tongues are called ice shelves. They prevent the huge amount of inland ice from quickly flowing into the ocean. However, as it gets warmer, the ice shelves may no longer serve as a buttress to the flow of grounded ice. Since less and less sea ice is forming, the water density on the continental shelf will decrease, thus allowing warm water to flow underneath the ice shelf and melt it from below. (Illustration: Alfred-Wegener-Institut/Martin Künsting CC-BY 4.0)

However, due to the warming of the atmosphere, the ice cover decreases continuously in summer at about 12 % per decade, and the dark ocean reflects only 10 % of the sun's rays. As a result, the ocean warms up, which leads to increased melting of the sea ice cover. In addition, the increased transport of moisture and heat towards the north affects the Arctic heat balance, which also contributes to "Arctic amplification"[23].

The primary reason for the stable, cold climate of Antarctica, in contrast to the Arctic, is that it is an ice-covered continent, separated from the rest of the world by a vast ring ocean. Due to the high reflectivity and the enormous thickness of the ice sheet, an extremely cold and dry climate prevails, which is characterised by a stable high-pressure area above it. As a result, warm air masses inflowing at high altitudes descend above the ice sheet, cooling down in the process and flowing towards the ocean as extremely cold down-winds (so-called catabatic winds), contributing to sea ice production in open seawater[19]. While significant warming is generally observed in the Arctic, Antarctic temperatures are rising primarily only in the West Antarctic and along the Antarctic Peninsula. The development of the sea ice situation in the Antarctic also differs from that in the Arctic, and in some cases varies greatly from region to region and season to season.

The atmosphere on the Antarctic Peninsula has warmed up by more than 2.5 degrees Celsius on average over the last 50 years, which has led, among other things, to the disintegration of some parts of the Larsen Ice Shelf and a decrease in sea ice in the western part of the peninsula and especially in the Bellingshausen and Amundsen Seas[24]. In the entire Weddell Sea, sea ice decreases slightly in winter, but not in summer[25,26]. It is important to note, however, that there are very large annual to decadal fluctuations, and that especially in recent times there have been more years with very low ice cover. Possible causes for these regional differences are changes in the circulation of the atmosphere and the ocean, which transport heat and moisture to Antarctica. While West Antarctica is experiencing heavy losses of inland ice, East Antarctica has so far been less affected and is even experiencing a slight mass influx in some areas due to increased snow accumulation[27].

What role do the Arctic and Antarctic play for the ocean?

The formation of sea ice in the polar regions influences the temperature- and salt-driven circulation of the ocean, which among other things drives the major ocean currents on our planet, ventilates the deep ocean and is responsible for the vertical transport of substances in the water column (thermohaline circulation). During the formation of sea ice, brine remains in the ocean, which causes the surface water to become increasingly salty and thus denser, and to sink to the depths. As a result of sinking in the high latitudes, surface water flows in from the lower latitudes, which is the only way to transport warm water towards the poles. The dense water masses in the polar oceans are called North Atlantic Deep Water or Antarctic Bottom Water, depending on the region, and are the driving force behind the thermohaline circulation. This global conveyor belt spans the entire globe and causes, among other things, the Gulf Stream to send warm water towards northern Europe. However, once formed, sea ice acts as an insulator and thus very effectively prevents the heat exchange between the warmer surface water and the cold atmosphere[19].

Sea ice also plays a decisive role in the fate of the large Antarctic ice shelves. On the continental shelf of the southern Weddell Sea, for example, so much sea ice forms during the autumn and winter months that the amount of salt released is sufficient to transform the water masses in front of and below the Filchner-Ronne Ice Shelf into a barrier of very salty water at about minus 2 degrees Celsius[28]. Up to now, this barrier has protected the ice shelf from the inflow of +0.8 degrees Celsius warm water masses from the marginal current of the Weddell Gyre. If the air temperature above the southern Weddell Sea rises as a result of climate change, leading to a decrease in sea ice formation, this density barrier could collapse, allowing warm water from the marginal current to enter the ice shelf cavern and cause severe melting at the base of the ice shelf[29]. This would accelerate the discharge of continental ice masses into the ocean and significantly raise sea levels[30].

What contribution does the Arctic / Antarctic make to sea-level rise?

The Greenland and Antarctic ice sheets store the largest quantities of freshwater on Earth[31]. If the ice masses of Antarctica and Greenland were to melt together, this would trigger a sea-level rise of about 65 m worldwide, with Antarctica storing about eight times more water than Greenland[32,33]. Greenland's total contribution to sea-level rise was 10.8 mm between 1992 and 2018, while the Antarctic ice sheet caused a rise of about 7.6 mm between 1992 and 2017[34,35].

However, the causes of ice loss are different in the two hemispheres. In Greenland, mass loss due to surface melt occurs primarily in the low-lying marginal areas and less through runoff from glaciers and ice streams that calve directly into the ocean or initially feed a floating glacier tongue.

Since surface temperatures in Antarctica are low all year round, surface melting plays hardly any role. However, large areas of ice shelf extend hundreds of kilometres into the Southern Ocean and prevent the ice masses from flowing unchecked from the interior of Antarctica to the lower coastal regions. The up to 1,600-metre thick ice shelf lies at the edges of bays and in places on deep-sea mountains and islands, which act like chocks to prevent the ice from sliding further. The warmer the ocean is, however, the more often these braking mechanisms fail, as is currently evident above all in West Antarctica (e.g. Amundsen Sea, Antarctic Peninsula) or on the Totten Glacier (East Antarctica)[36,37].

The crocodile icefish has adapted to the frosty cold of the Southern Ocean through the development of antifreeze proteins and the loss of its red blood pigment. As a result, it would suffer particularly from a possible circumpolar warming of the Southern Ocean. (Photo: Julian Gutt and Werner Dimmler, MARUM/AWI)

Like every mass on Earth, the inland ice of Antarctica and Greenland exert a gravitational attraction. Melting and calving reduce the ice mass, its gravity decreases and the seawater is less strongly attracted. As a result, sea levels near the ice sheets fall. Away from the ice sheets, sea level rises disproportionately. Projections with an undiminished rise in CO_2 by the year 2100 predict a sea-level rise of up to 89 ± 51 mm due to the melting of Greenland. These are very uncertain for Antarctica due to a variety of factors but show a possible contribution of -70 mm to +300 mm[38,39].

Can the extremely specialised polar ecosystems withstand the challenges posed by climate change?

Although extreme environmental conditions such as cold, snow, ice and prolonged darkness in the winter months prevail in the polar regions, they provide a surprisingly large number of species with a habitat, especially in the oceans. Comparing the two polar regions, there are many similarities, but even more important differences[40]. While the Arctic has large, glacier-free tundra areas and extensive river systems that produce sufficient biomass in summer to feed large herbivores, the landmass of the Antarctic has been covered with kilometre-thick inland ice for many millions of years and, despite rapid climate change, is still 98% covered today. The polar regions are home to many species that only occur here and are perfectly adapted to the apparently hostile conditions prevailing there. However, as the Arctic and parts of the Antarctic warm up twice as fast as the rest of the world, the highly specialised organisms and biotic communities of both regions are under particularly high pressure to adapt. This is because climate change is rapidly changing the basic environmental conditions in both polar regions, especially in the Arctic and in the Antarctic Peninsula.

For the ecosystems, biotic communities and organisms there, this entails the risk that they will not be able to adapt to the rapid change with the necessary speed[41]. One of the most apparent and ecologically far-reaching changes is the disappearance of sea ice, which could lead to the extinction of species that depend on this particular, typically polar habitat. Moreover, this loss of polar biodiversity affects not only the life cycles of individual organisms but also the entire marine food web. In addition, both marine and terrestrial habitats are threatened by rising temperatures and the resulting poleward shift in the distribution limits of species and communities[42,43].

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