Coordinates: 90°S 0°E

Antarctica

Antarctica (/ænˈtɑːrtɪkə/ or /ænˈtɑːrktɪkə/ (listen))[note 1] is Earth's southernmost continent. It contains the geographic South Pole and is situated in the Antarctic region of the Southern Hemisphere, almost entirely south of the Antarctic Circle, and is surrounded by the Southern Ocean. At 14,200,000 square kilometres (5,500,000 square miles), it is the fifth-largest continent and nearly twice the size of Australia. It is by far the least populated continent, with around 5,000 people in the summer and around 1,000 in the winter. About 98% of Antarctica is covered by ice that averages 1.9 km (1.2 mi; 6,200 ft) in thickness,[5] which extends to all but the McMurdo Dry Valleys and the northernmost reaches of the Antarctic Peninsula.[6]

Antarctica, on average, is the coldest, driest, and windiest continent, and has the highest average elevation of all the continents.[7] Most of Antarctica is a polar desert, with annual precipitation of 200 mm (7.9 in) along the coast and far less inland; yet 80% of the world freshwater reserves are stored there, enough to raise global sea levels by about 60 metres (200 ft) if all of it were to melt.[8][6] The temperature in Antarctica has dropped to −89.2 °C (−128.6 °F) (or even −94.7 °C (−135.8 °F) as measured from space[9]), though the average for the third quarter (the coldest part of the year) is −63 °C (−81 °F). Organisms native to Antarctica include many types of algae, bacteria, fungi, plants, protista, and certain animals, such as mites, nematodes, penguins, seals and tardigrades. Vegetation, where it occurs, is tundra.

Antarctica

Area	14,200,000 km²[1] 5,500,000 sq mi
Population	1,000 to 5,000 (seasonal)
Population density	<0.01 per km² <0.01 per sq mi
Demonym	Antarctic
Internet TLD	.aq
Largest cities	Research stations McMurdo Station
UN M49 code	010

Antarctica was the last region on Earth to be discovered, unseen until 1820 when the Russian expedition of Fabian Gottlieb von Bellingshausen and Mikhail Lazarev on *Vostok* and *Mirny* sighted the Fimbul ice shelf. The continent remained largely neglected for the rest of the 19th century because of its harsh environment, lack of easily accessible resources, and isolation. In January 1840, land at Antarctica was discovered for the first time, almost simultaneously, by the United States Exploring Expedition, under Lieut. Charles Wilkes, and a separate French expedition under Jules Dumont d'Urville. The latter made a temporary landing; while the Wilkes expedition, though it did not make a landing, did remain long enough in the region to survey and map some 800 miles of the continent. The first confirmed landing was by a team of Norwegians in 1895.

Antarctica is governed by parties to the Antarctic Treaty System. Twelve countries signed the Antarctic Treaty in 1959, and thirty-eight have signed it since then. The treaty prohibits military activities, mineral mining, nuclear explosions and nuclear waste disposal. It supports scientific research and protects the continent's ecology. Between 1,000 and 5,000 people from many countries reside at research stations scattered across the continent.

Contents

Etymology

The name *Antarctica* is the romanised version of the Greek compound word ἀνταρκτική (*antarktikḗ*), feminine of ἀνταρκτικός (*antarktikós*),[10] meaning "opposite to the Arctic", "opposite to the north".[11][12]

Aristotle wrote in his book *Meteorology* about an *Antarctic region* in c. 350 BC.[13] Marinus of Tyre reportedly used the name in his unpreserved world map from the 2nd century CE.[14] The Roman authors Hyginus and Apuleius (1–2 centuries CE) used for the South Pole the romanised Greek name *polus*

antarcticus,[15][16] from which derived the Old French *pole antartike* (modern *pôle antarctique*) attested in 1270, and from there the Middle English *pol antartik* in a 1391 technical treatise by Geoffrey Chaucer, *A Treatise on the Astrolabe*, referring to the modern *Antarctic Pole*.[17]

Adélie penguins in Antarctica

Change of name

The long-imagined (but undiscovered) south polar continent was originally called *Terra Australis*, sometimes shortened to *Australia* as seen in a woodcut illustration titled "Sphere of the winds", contained in an astrological textbook published in Frankfurt in 1545.[18]

In the early 19th century, the colonial authorities in Sydney removed the Dutch name from New Holland. Instead of inventing a new name to replace it, they took the name *Australia* from the south polar continent, leaving it nameless for some eighty years. During that period, geographers had to make do with clumsy phrases such as "the Antarctic Continent". They searched for a more poetic replacement, suggesting various names such as Ultima and Antipodea.[19] Eventually *Antarctica* was adopted as the continental name in the 1890s—the first use of the name is attributed to the Scottish cartographer John George Bartholomew.[20]

History of exploration

Antarctica has no indigenous population.[21] In February 1775, during his second voyage, Captain Cook called the existence of such a polar continent "probable" and in another copy of his journal he wrote: "[I] firmly believe it and it's more than probable that we have seen a part of it".[22]

The First Russian Antarctic Expedition 1819–1821, led by Fabian Gottlieb von Bellingshausen.

However, belief in the existence of a *Terra Australis*—a vast continent in the far south of the globe to "balance" the northern lands of Europe, Asia and North Africa—had prevailed since the times of Ptolemy in the 1st century AD. Even in the late 17th century, after explorers had found that South America and Australia were not part of the fabled "Antarctica", geographers believed that the continent was much larger than its actual size. Integral to the story of the origin of Antarctica's name is that it was not named *Terra Australis*—this name was given to Australia instead, because of the misconception that no significant landmass could exist further south. Explorer Matthew Flinders, in particular, has been credited with popularising the transfer of the name *Terra Australis* to Australia. He justified the titling of his book *A Voyage to Terra Australis* (1814) by writing in the introduction:

> There is no probability, that any other detached body of land, of nearly equal extent, will ever be found in a more southern latitude; the name Terra Australis will, therefore, remain descriptive of the geographical importance of this country and of its situation on the globe: it has antiquity to recommend it; and, having no reference to either of the two claiming nations, appears to be less objectionable than any other which could have been selected.[23]

European maps continued to show this hypothetical land until Captain James Cook's ships, HMS *Resolution* and *Adventure*, crossed the Antarctic Circle on 17 January 1773, in December 1773 and again in January 1774.[24] Cook came within about 120 km (75 mi) of the Antarctic coast before retreating in the face of field ice in January 1773.[25]

According to various organisations (the National Science Foundation,[26] NASA,[27] the University of California, San Diego,[28] the Russian State Museum of the Arctic and Antarctic,[29] among others),[30][31] ships captained by three men sighted Antarctica or its ice shelf in 1820: Fabian Gottlieb von Bellingshausen, a captain in the Imperial Russian Navy, Edward Bransfield, a captain in the Royal Navy, and Nathaniel Palmer, an American sealer.[32]

The First Russian Antarctic Expedition led by Bellingshausen and Mikhail Lazarev on the 985-ton sloop-of-war *Vostok* ("East") and the 530-ton support vessel *Mirny* ("Peaceful") reached a point within 32 km (20 mi) of Queen Maud's Land and recorded the sight of an ice shelf at 69°21′28″S 2°14′50″W,[33] on 27 January 1820,[34] which became known as the Fimbul ice shelf. This happened three days before Bransfield sighted the land of the Trinity Peninsula of Antarctica, as opposed to the ice of an ice shelf, and ten months before Palmer did so in November 1820. The first documented landing on Antarctica was by the American sealer John Davis, apparently at Hughes Bay, near Cape Charles, in West Antarctica on 7 February 1821, although some historians dispute this claim.[35][36] The first recorded and confirmed landing was at Cape Adair in 1895 (by the Norwegian-Swedish whaling ship *Antarctic*).[37]

On 22 January 1840, two days after the discovery of the coast west of the Balleny Islands, some members of the crew of the 1837–40 expedition of Jules Dumont d'Urville disembarked on the highest islet[38] of a group of coastal rocky islands about 4 km from Cape Géodésie on the coast of Adélie Land where they took some mineral, algae, and animal samples, erected the French flag and claimed French sovereignty over the territory.[39]

Discovery and claim of French sovereignty over Adélie Land by Jules Dumont d'Urville, in 1840.

Painting of James Weddell's second expedition in 1823, depicting the brig *Jane* and the cutter *Beaufoy*

Nimrod Expedition South Pole Party (left to right): Wild, Shackleton, Marshall and Adams

Explorer James Clark Ross passed through what is now known as the Ross Sea and discovered Ross Island (both of which were named after him) in 1841. He sailed along a huge wall of ice that was later named the Ross Ice Shelf. Mount Erebus and Mount Terror are named after two ships from his expedition: HMS *Erebus* and *Terror*.[40] Mercator Cooper landed in East Antarctica on 26 January 1853.[41]

During the *Nimrod* Expedition led by Ernest Shackleton in 1907, parties led by Edgeworth David became the first to climb Mount Erebus and to reach the South Magnetic Pole. Douglas Mawson, who assumed the leadership of the Magnetic Pole party on their perilous return, went on to lead several expeditions until retiring in 1931.[42] In addition, Shackleton and three other members of his expedition made several firsts in December 1908 – February 1909: they were the first humans to traverse the Ross Ice Shelf, the first to traverse the Transantarctic Mountains (via the Beardmore Glacier), and the first to set foot on the South Polar Plateau. An expedition led by Norwegian polar explorer Roald Amundsen from the ship *Fram* became the first to reach the geographic South Pole on 14 December 1911, using a route from the Bay of Whales and up the Axel Heiberg Glacier.[43] One month later, the doomed Scott Expedition reached the pole.[44]

Richard E. Byrd led several voyages to the Antarctic by plane in the 1930s and 1940s. He is credited with implementing mechanised land transport on the continent and conducting extensive geological and biological research.[45] The first women to set foot on Antarctica were Caroline Mikkelsen, who landed on an island of Antarctica in 1935,[46] and Ingrid Christensen who stepped onto the mainland in 1937.[47][48][49]

It was not until 31 October 1956, that anyone set foot on the South Pole again; on that day a U.S. Navy group led by Rear Admiral George J. Dufek successfully landed an aircraft there.[50] The first women to step onto the South Pole were Pam Young, Jean Pearson, Lois Jones, Eileen McSaveney, Kay Lindsay and Terry

Tickhill in 1969.[51]

In the southern hemisphere summer of 1996–97 the Norwegian explorer Børge Ousland became the first person to cross Antarctica alone from coast to coast.[52] Ousland got aid from a kite on parts of the distance. All attempted crossings, with no kites or resupplies, that have tried to go from the true continental edges, where the ice meets the sea, have failed due to the great distance that needs to be covered.[53] For this crossing, Ousland also holds the record for the fastest unsupported journey to the South Pole, taking just 34 days.[54]

Roald Amundsen and his crew looking at the Norwegian flag they had raised at the South Pole, 1911

The French Dumont d'Urville Station, an example of modern human settlement in Antarctica

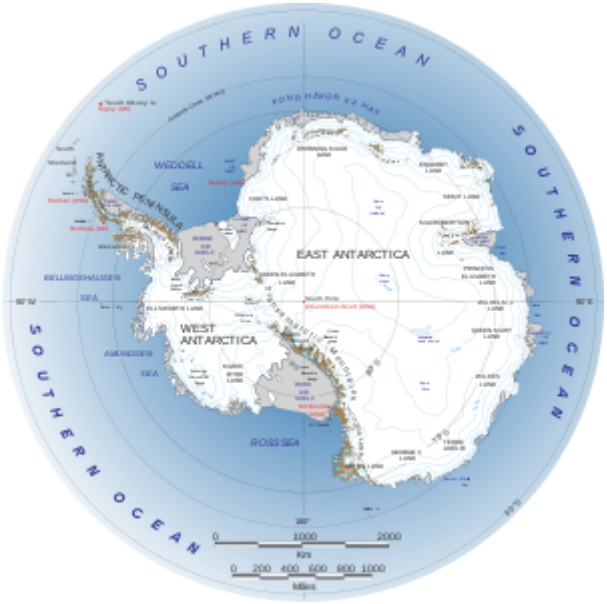
In 1997 Børge Ousland became the first person to make a solo crossing.

Geography

Positioned asymmetrically around the South Pole and largely south of the Antarctic Circle, Antarctica is the southernmost continent and is surrounded by the Southern Ocean; alternatively, it may be considered to be surrounded by the southern Pacific, Atlantic, and Indian Oceans, or by the southern waters of the World Ocean. There are a number of rivers and lakes in Antarctica, the longest river being the Onyx. The largest lake, Vostok, is one of the largest sub-glacial lakes in the world. Antarctica covers more than 14 million km^2 (5,400,000 sq mi),[1] making it the fifth-largest continent, about 1.3 times as large as Europe. The coastline measures 17,968 km (11,165 mi)[1] and is mostly characterised by ice formations, as the following table shows:

Coastal types around Antarctica[55]

Type	Portion
Ice shelf (floating ice front)	44%
Ice walls (resting on ground)	38%
Ice stream/outlet glacier (ice front or ice wall)	13%
Rock	5%
Total	100%



Eastern Antarctica is to the right of the Transantarctic Mountains and Western Antarctica is to the left.

Antarctica is divided in two by the Transantarctic Mountains close to the neck between the Ross Sea and the Weddell Sea. The portion west of the Weddell Sea and east of the Ross Sea is called West Antarctica and the remainder East Antarctica.[56]

About 98% of Antarctica is covered by the Antarctic ice sheet, a sheet of ice averaging at least 1.6 km (1.0 mi) thick. The continent has about 90% of the world's ice (and thus about 70% of the world's fresh water). If all of this ice were melted, sea levels would rise about 60 m (200 ft).[57] In most of the interior of the continent, precipitation is very low, down to 20 mm (0.8 in) per year; in a few "blue ice" areas precipitation is lower than mass loss by sublimation, and so the local mass balance is negative. In the dry valleys, the same effect occurs over a rock base, leading to a desiccated landscape.[58]

West Antarctica is covered by the West Antarctic Ice Sheet. The sheet has been of recent concern because of the small possibility of its collapse. If the sheet were to break down, ocean levels would rise by several metres in a relatively short geologically period of time, perhaps a matter of centuries.[59] Several Antarctic ice streams flow to one of the many Antarctic ice shelves, a process known as ice-sheet dynamics.[60]

Elevation coloured by relief height

East Antarctica lies on the Indian Ocean side of the Transantarctic Mountains and comprises Coats Land, Queen Maud Land, Enderby Land, Mac. Robertson Land, Wilkes Land, and Victoria Land. All but a small portion of this region lies within the Eastern Hemisphere. East Antarctica is largely covered by the East Antarctic Ice Sheet.[61]

Vinson Massif, the highest peak in Antarctica at 4,892 m (16,050 ft), is located in the Ellsworth Mountains.[62] Antarctica contains many other mountains, on both the main continent and the surrounding islands. Mount Erebus on Ross Island is the world's southernmost active volcano. Another well-known volcano is found on Deception Island, which is famous for a giant eruption in 1970. Minor eruptions are frequent, and lava flow has been observed in recent years. Other dormant volcanoes may potentially be active.[63] In 2004, a potentially active underwater volcano was found in the Antarctic Peninsula by American and Canadian researchers.[64]

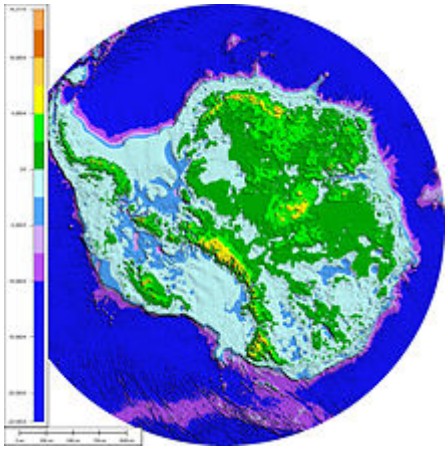
Mount Erebus, an active volcano on Ross Island

Antarctica is home to more than 70 lakes that lie at the base of the continental ice sheet. Lake Vostok, discovered beneath Russia's Vostok Station in 1996, is the largest of these subglacial lakes. It was once believed that the lake had been sealed off for 500,000 to one million years, but a recent survey suggests that, every so often, there are large flows of water from one lake to another.[65]

There is some evidence, in the form of ice cores drilled to about 400 m (1,300 ft) above the water line, that Lake Vostok's waters may contain microbial life. The frozen surface of the lake shares similarities with Jupiter's moon Europa. If life is discovered in Lake Vostok, it would strengthen the argument for the possibility of life on Europa.[66][67] In 2008, a NASA team embarked on a mission to Lake Untersee, searching for extremophiles in its highly alkaline waters. If found, these resilient creatures could further bolster the argument for extraterrestrial life in extremely cold, methane-rich environments.[68]

In September 2018, researchers at the National Geospatial-Intelligence Agency released a high resolution terrain map (detail down to the size of a car, and less in some areas) of Antarctica, named the "Reference Elevation Model of Antarctica" (REMA).[69][70]

Geology



Subglacial topography and bathymetry of bedrock underlying Antarctica ice sheet

More than 100 million years ago, Antarctica was part of the supercontinent Gondwana.[71] Over time, Gondwana gradually broke apart, and Antarctica as we know it today was formed around 25 million years ago, when the Drake Passage opened between it and South America.[72] Antarctica was not always cold, dry, and covered in ice sheets. At a number of points in its history, it was farther north, experienced a tropical or temperate climate, and was covered in forests.[73]

Palaeozoic era (540–250 Ma)

During the Cambrian period, Gondwana had a mild climate.[74] West Antarctica was partially in the Northern Hemisphere, and during this period large amounts of sandstones, limestones and shales were deposited. East Antarctica was at the equator, where seafloor invertebrates and trilobites flourished in the tropical seas. By the start of the Devonian period (416 Ma), Gondwana was in more southern latitudes and the climate was cooler, though fossils of land plants are known from this time. Sand and silts were laid down in what is now the Ellsworth, Horlick and Pensacola Mountains. Glaciation began at the end of the Devonian period (360 Ma), as Gondwana became centred on the South Pole and the climate cooled, though flora remained.[75] During the Permian period, the land became dominated by seed plants such as *Glossopteris*, a pteridosperm which grew in swamps. Over time these swamps became deposits of coal in the Transantarctic Mountains. Towards the end of the Permian period, continued warming led to a dry, hot climate over much of Gondwana.[76]

Mesozoic era (250–66 Ma)

As a result of continued warming, the polar ice caps melted and much of Gondwana became a desert. In Eastern Antarctica, seed ferns or pteridosperms became abundant and large amounts of sandstone and shale were laid down at this time. Synapsids, commonly known as "mammal-like reptiles" and which included species such as *Lystrosaurus*, were common in Antarctica during the Early Triassic.[77][78] The Antarctic Peninsula began to form during the Jurassic period (206–146 Ma).[79] Ginkgo trees, conifers, bennettites, horsetails, ferns and cycads were plentiful during this period.[80] In West Antarctica, coniferous forests

dominated through the entire Cretaceous period (146–66 Ma), though southern beech became more prominent towards the end of this period.[81][82] Ammonites were common in the seas around Antarctica, and dinosaurs were also present, though only three Antarctic dinosaur genera (*Cryolophosaurus* and *Glacialisaurus*, from the Hanson Formation,[83] and *Antarctopelta*) have been described to date.[84] It was during this era that Gondwana began to break up. There is some evidence of Antarctic marine glaciation during the Cretaceous period.[85]

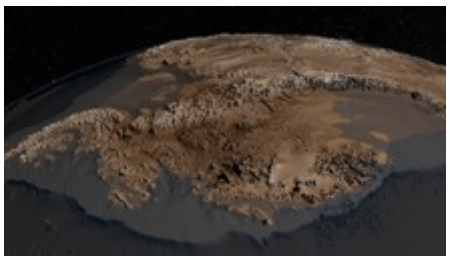
Skeletal reconstruction of *Cryolophosaurus*, as found in Antarctica

Gondwana breakup (160–23 Ma)

The cooling of Antarctica occurred stepwise, as the continental spread changed the oceanic currents from longitudinal equator-to-pole temperature-equalising currents to latitudinal currents that preserved and accentuated latitude temperature differences.

Africa separated from Antarctica in the Jurassic, around 160 Ma, followed by the Indian subcontinent in the early Cretaceous (about 125 Ma). By the end of the Cretaceous, about 66 Ma, Antarctica (then connected to Australia) still had a subtropical climate and flora, complete with a marsupial fauna.[86] In the Eocene epoch, about 40 Ma Australia-New Guinea separated from Antarctica, so that latitudinal currents could isolate Antarctica from Australia, and the first ice began to appear. During the Eocene–Oligocene extinction event about 34 million years ago, CO_2 levels have been found to be about 760 ppm,[87] and had been decreasing from earlier levels in the thousands of ppm.[88]

Around 25 Ma, the Drake Passage opened between Antarctica and South America, resulting in the Antarctic Circumpolar Current that completely isolated the continent. Models of the changes suggest that declining CO_2 levels became more important.[89] The ice began to spread, replacing the forests that until then had covered the continent. Since about 15 Ma, the continent has been mostly covered with ice.[90]



The bedrock topography of Antarctica, critical to understand dynamic motion of the continental ice sheets

Pliocene and Pleistocene

Fossil *Nothofagus* leaves in the Meyer Desert Formation of the Sirius Group show that intermittent warm periods allowed *Nothofagus* shrubs to cling to the Dominion Range as late as 3–4 Ma (mid-late Pliocene).[91] After that, the Pleistocene ice age covered the whole continent and destroyed all major plant life on it.[92]

A study from 2014 estimated that during the Pleistocene, the East Antarctic Ice Sheet (EAIS) thinned by at least 500 m (1,600 ft), and that thinning since the Last Glacial Maximum for the EAIS area is less than 50 m (160 ft) and probably started after c. 14 ka.[93]

About 2,200 years ago, a volcano erupted under Antarctica's ice sheet, as detected by an airborne survey with radar images. The biggest eruption in Antarctica in the last 10,000 years, the volcanic ash was found deposited on the ice surface under the Hudson Mountains, close to Pine Island Glacier.[94]

Present-day

The geological study of Antarctica has been greatly hindered by nearly all of the continent being permanently covered with a thick layer of ice.[95] However, new techniques such as remote sensing, ground-penetrating radar and satellite imagery have begun to reveal the structures beneath the ice. Geologically, West Antarctica closely resembles the Andes mountain range of South America.[76] The Antarctic Peninsula was formed by uplift and metamorphism of sea bed sediments.[96]

Glaciers and rock outcrops in Marie Byrd Land seen from NASA's DC-8 aircraft

The most common rocks in West Antarctica are andesite and rhyolite volcanics formed during the Jurassic period. There is also evidence of volcanic activity, even after the ice sheet had formed, in Marie Byrd Land and Alexander Island. The only anomalous area of West Antarctica is the Ellsworth Mountains region, where the stratigraphy is more similar to East Antarctica.[97]

East Antarctica is geologically varied, dating from the Precambrian era, with some rocks formed more than 3 billion years ago. It is composed of a metamorphic and igneous platform which is the basis of the continental shield. On top of this base are coal and various modern rocks, such as sandstones, limestones and shales laid down during the Devonian and Jurassic periods to form the Transantarctic Mountains.[98] In coastal areas such as the Shackleton Range and Victoria Land some faulting has occurred.[99][100]

The main mineral resource known on the continent is coal.[90] It was first recorded near the Beardmore Glacier by Frank Wild on the Nimrod Expedition, and now low-grade coal is known across many parts of the Transantarctic Mountains. The Prince Charles Mountains contain significant deposits of iron ore. The most valuable resources of Antarctica lie offshore, namely the oil and natural gas fields found in the Ross Sea in 1973. Exploitation of all mineral resources is banned until 2048 by the Protocol on Environmental Protection to the Antarctic Treaty.[101]

Climate

Antarctica is the coldest of Earth's continents. It was ice-free until about 34 million years ago, when it became covered with ice.[102] The lowest natural air temperature ever recorded on Earth was −89.2 °C (−128.6 °F) at the Russian Vostok Station in Antarctica on 21 July 1983.[103] A lower air temperature of −94.7 °C (−138.5 °F) was recorded in 2010 by satellite—however, it may have been influenced by ground temperatures and was not recorded at a height of 2 metres (7 ft) above the surface as required for official air temperature records.[104] Temperatures reach a minimum of between −80 °C (−112 °F) and −89.2 °C (−128.6 °F) in the interior in winter and reach a maximum of between 5 °C (41 °F) and 15 °C (59 °F) near the coast in summer. Northern Antarctica recorded a temperature of 20.8 °C (69.4 °F) on 9 February 2020, the highest recorded temperature on the continent.[105][106]

The blue ice covering Lake Fryxell, in the Transantarctic Mountains, comes from glacial meltwater from the Canada Glacier and other smaller glaciers.

Antarctica is a frozen desert with little precipitation; the South Pole receives less than 10 mm (0.4 in) per year, on average. Sunburn is often a health issue as the snow surface reflects almost all of the ultraviolet light falling on it. Given the latitude, long periods of constant darkness or constant sunlight create climates unfamiliar to human beings in much of the rest of the world.[107]

The aurora australis, commonly known as the southern lights, is a glow observed in the night sky near the South Pole created by the plasma-full solar winds that pass by the Earth. Another unique spectacle is diamond dust, a ground-level cloud composed of tiny ice crystals. It generally forms under otherwise clear or nearly clear skies, so people sometimes also refer to it as clear-sky precipitation. A sun dog, a frequent atmospheric optical phenomenon, is a bright "spot" beside the true sun.[107]

Near the coast, December looks fairly temperate.

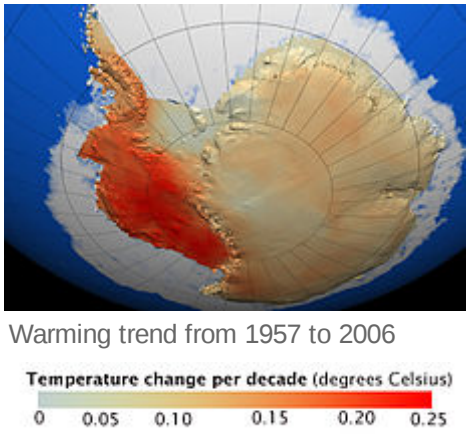
Regional climate

East Antarctica is colder than its western counterpart because of its higher elevation. Weather fronts rarely penetrate far into the continent, leaving the centre cold and dry. Despite the lack of precipitation over the central portion of the continent, ice there lasts for extended periods. Heavy snowfalls are common on the coastal portion of the continent, where snowfalls of up to 1.22 metres (48 in) in 48 hours have been recorded. At the continent's edge, strong katabatic winds off the polar plateau often blow at storm force. In the interior, wind speeds are typically moderate. During clear days in summer, more solar radiation reaches the surface at the South Pole than at the equator because of the 24 hours of sunlight each day at the Pole.[1]

Antarctica is colder than the Arctic for three reasons. First, much of the continent is more than 3,000 m (9,800 ft) above sea level, and temperature decreases with elevation in the troposphere. Second, the Arctic Ocean covers the north polar zone: the ocean's relative warmth is transferred through the icepack and prevents temperatures in the Arctic regions from reaching the extremes typical of the land surface of Antarctica. Third, the Earth is at aphelion in July (i.e., the Earth is farthest from the Sun in the Antarctic winter), and the Earth is at perihelion in January (i.e., the Earth is closest to the Sun in the Antarctic summer). The orbital distance contributes to a colder Antarctic winter (and a warmer Antarctic summer) but the first two effects have more impact.[108]

Climate change

Some of Antarctica has been warming up; particularly strong warming has been noted on the Antarctic Peninsula. A study by Eric Steig published in 2009 noted for the first time that the continent-wide average surface temperature trend of Antarctica was slightly positive from 1957 to 2006.[109] Over the second half of the 20th century, the Antarctic Peninsula was the fastest-warming place on Earth, closely followed by West Antarctica, but these trends weakened in the early 21st-century.[110] Conversely, the South Pole in East Antarctica barely warmed last century, but temperatures shall have three times the global average in the last three decades.[111] In February 2020, the continent recorded its highest temperature of 18.3 °C (64.9 °F), which was a degree higher than the previous record of 17.5 °C (63.5 °F) in March 2015.[112]



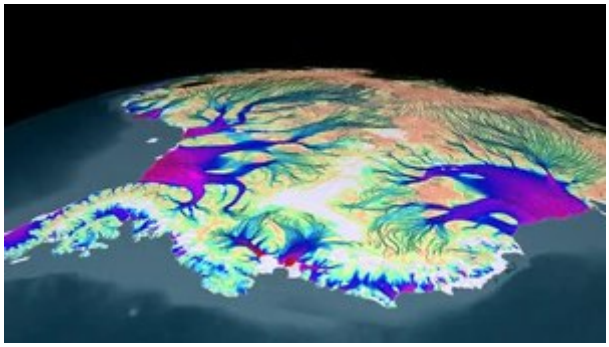
Warming trend from 1957 to 2006

There is some evidence that surface warming in Antarctica is due to human greenhouse gas emissions,[113] but this is difficult to determine due to internal variability.[114] A main component of climate variability in Antarctica is the Southern Annular Mode, which showed strengthened winds around Antarctica in summer of the later decades of the 20th century, associated with cooler temperatures over the continent. The trend was at a scale unprecedented over the last 600 years; the most dominant driver of this mode of variability is likely the depletion of ozone above the continent.[115]

In 2002 the Antarctic Peninsula's Larsen-B ice shelf collapsed.[116] Between 28 February and 8 March 2008, about 570 km^2 (220 sq mi) of ice from the Wilkins Ice Shelf on the southwest part of the peninsula collapsed, putting the remaining 15,000 km^2 (5,800 sq mi) of the ice shelf at risk. The ice was being held back by a "thread" of ice about 6 km (4 mi) wide,[117][118] prior to its collapse on 5 April 2009.[119][120]

Ice loss and global sea level

Due to its location at the South Pole, Antarctica receives relatively little solar radiation except along the southern summer. This means that it is a very cold continent where water is mostly in the form of ice. Precipitation is low (most of Antarctica is a desert) and almost always in the form of snow, which accumulates and forms the giant ice sheets which cover the continent.[121] Parts of this ice sheet form moving glaciers known as ice streams, which flow towards the edges of the continent.[122] Next to the continental shore are many ice shelves. These are floating extensions of outflowing glaciers from the continental ice mass. Offshore, temperatures are also low enough that ice is formed from seawater through most of the year.



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The motion of ice in Antarctica

Sea ice and ice shelves

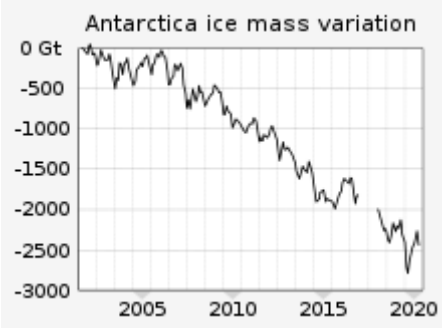
Sea ice extent expands annually in the Antarctic winter and most of this ice melts in the summer. This ice is formed from the ocean water and floats in the same water and thus does not contribute to a rise in sea level.[123] The extent of sea ice around Antarctica, in terms of square kilometres of coverage, has seen no significant trend in the satellite era (1978–2018), with initial growth being reversed in the last years of the record. A possible explanation for the difference between the Antarctic and the Arctic, which has seen rapid sea ice loss, is that thermohaline circulation transports warmed water to deeper layers in the ocean. The amount of variation it has experienced in its thickness is unclear with satellite techniques just emerging as of 2019.[124]

Melting of floating ice shelves (ice that originated on the land) does not in itself contribute much to sea-level rise, since the ice displaces only its own mass of water. However, ice sheets work as a stabilizer of the land ice, and are vulnerable to warming water. Recent decades have witnessed several dramatic collapses of large ice shelves around the coast of Antarctica, especially along the Antarctic Peninsula.[125] This loss of ice shelf "buttressing" has been identified as the major cause of ice loss on the West Antarctic ice sheet, but has also been observed around the East Antarctic ice sheet.[126]

Ice sheet loss and sea level rise

The Antarctic ice sheet is losing mass as ice flows faster into the ocean than before. This effect is partially offset by additional snow falling back onto the continent.[128] A 2018 systematic review study estimated that ice loss across the entire continent was 43 gigatonnes per year on average during the period from 1992 to 2002

but accelerated to an average of 220 gigatonnes per year during the five years from 2012 to 2017.[129] The total contribution to sea level rise has been estimated as 8 mm to 14 mm of sea level rise.[128][130]



Ice mass loss since 2002, as measured by NASA's GRACE and GRACE Follow-On satellite projects, was 149 billion metric tons per year. Time between projects caused gap in data.[127]

On the continent itself, the large volume of ice present stores around 70% of the world's fresh water.[57] East Antarctica is a cold region with a ground base above sea level and occupies most of the continent. This area is dominated by small accumulations of snowfall which becomes ice and thus eventually seaward glacial flows. Estimates of the mass balance of the East Antarctic Ice Sheet as a whole range from slightly positive to slightly negative.[131][130] Increased ice outflow has been observed in some regions.[130]

Future projections of ice loss depend on the speed of climate change mitigation and are uncertain. Tipping points have been identified in some regions; when a certain threshold warming is reached, these regions may start melting significantly faster and irreversibly. That is, even when temperatures come down again, the ice will not immediately regrow.[132] [133]

Ozone depletion

There is a large area of low ozone concentration or "ozone hole" over Antarctica. The hole, reoccurring every spring since the 1970s, was detected by scientists in 1985.[135] This hole covers almost the whole continent and was at its largest in September 2006;[134] the longest-lasting event occurred in 2020.[136] The ozone hole is attributed to the emission of chlorofluorocarbons or CFCs into the atmosphere, which decompose the ozone into other gases.[137] In 2019, the ozone hole was at its smallest in the previous thirty years, due to the warmer polar stratosphere weakening the polar vortex. This reduced the formation of the 'polar stratospheric clouds' that enable the chemistry that leads to rapid ozone loss.[138]

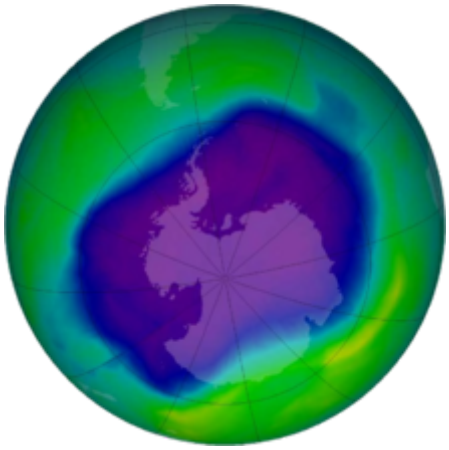


Image of the largest Antarctic ozone hole ever recorded due to CFCs accumulation (September 2006)[134]

Ozone depletion may have a dominant role in governing climatic change in Antarctica (and a wider area of the Southern Hemisphere).[135] Ozone absorbs large amounts of ultraviolet radiation in the stratosphere. Ozone depletion over Antarctica can cause a cooling of around 6 °C in the local stratosphere. This cooling has the effect of intensifying the westerly winds which flow around the continent (the polar vortex) and thus prevents outflow of the cold air near the South Pole. As a result, the continental mass of the East Antarctic ice sheet is held at lower temperatures, and the peripheral areas of Antarctica, especially the Antarctic Peninsula, are subject to higher temperatures, which promote accelerated melting.[135] Models suggest that ozone depletion and the enhanced polar vortex effect also account for the period of increased sea ice just offshore of the continent.[139][140]

Biodiversity

The terrestrial and native year-round species appear to be the descendants of ancestors who lived in geothermally warmed environments during the last ice age when these areas were the only places on the continent not covered by ice.[141]

Animals

Emperor penguins with juveniles

Invertebrate life of Antarctica includes microscopic mites like the *Alaskozetes antarcticus*, lice, nematodes, tardigrades, rotifers, krill and springtails. The flightless midge *Belgica antarctica*, up to 6 mm ($^1/_4$ in) in size, is the largest purely terrestrial animal in Antarctica.[142] Members of Chironomidae include *Parochlus steinenii*.[143] Antarctic krill, which congregate in large schools, is the keystone species of the ecosystem of the Southern Ocean, and is an important food organism for whales, seals, leopard seals, fur seals, squid, icefish, penguins, albatrosses and many other birds.[144]

Few terrestrial vertebrates live in Antarctica, and those that do are limited to the sub-Antarctic islands.[145] Some species of marine animals exist and rely, directly or indirectly, on the phytoplankton. Antarctic sea life includes penguins, blue whales, orcas, colossal squids and fur seals. The emperor penguin is the only penguin that breeds during the winter in Antarctica; it and the Adélie penguin breed farther south than any other penguin.[146] The snow petrel is one of only three birds that breed exclusively in Antarctica.[147] The Antarctic fur seal was very heavily hunted in the 18th and 19th centuries for its pelt by sealers from the United States and the United Kingdom.[148][149] The Weddell seal, a "true seal", is named after Sir James Weddell, commander of British sealing expeditions in the Weddell Sea.[150] The leopard seal is an apex predator in the Antarctic ecosystem, and they migrate across the Southern Ocean in search for food.[151]

A census of sea life carried out during the International Polar Year and which involved some 500 researchers was released in 2010. The research is part of the global Census of Marine Life and has disclosed some remarkable findings. More than 235 marine organisms live in both polar regions, having bridged the gap of 12,000 km (7,456 mi). Large animals such as some cetaceans and birds make the round trip annually. More surprising are small forms of life such as sea cucumbers and free-swimming snails found in both polar oceans. Various factors may aid in their distribution – fairly uniform temperatures of the deep ocean at the poles and the equator which differ by no more than 5 °C, and the major current systems or marine conveyor belt which transport eggs and larval stages.[152]

Fungi

About 400 species of lichen-forming fungi are known to exist in Antarctica.

About 1,150 species of fungi have been recorded from Antarctica, of which about 750 are non-lichen-forming and 400 are lichen-forming.[153][154] Some of these species are cryptoendoliths as a result of evolution under extreme conditions, and have significantly contributed to shaping the impressive rock formations of the McMurdo Dry Valleys and surrounding mountain ridges. The apparently simple morphology, scarcely differentiated structures, metabolic systems and enzymes still active at very low temperatures, and reduced life cycles shown by such fungi make them particularly suited to harsh environments such as the McMurdo Dry Valleys. In particular, their thick-walled and strongly melanised cells make them resistant to UV light. Those features can also be observed in algae and cyanobacteria, suggesting that these are adaptations to the conditions prevailing in Antarctica. This has led to speculation that, if life ever occurred on Mars, it might have looked similar to Antarctic fungi such as *Cryomyces antarcticus*, and *Cryomyces minteri*.[155][156] Some of these fungi are also apparently endemic

to Antarctica. Endemic Antarctic fungi also include certain dung-inhabiting species which have had to evolve in response to the double challenge of extreme cold while growing on dung, and the need to survive passage through the gut of warm-blooded animals.[157]

Plants

About 300 million years ago Permian forests started to cover the continent, and tundra vegetation survived as late as 15 million years ago,[158] but the climate of present-day Antarctica does not allow extensive vegetation to form. A combination of freezing temperatures, poor soil quality, lack of moisture, and lack of sunlight inhibit plant growth. As a result, the diversity of plant life is very low and limited in distribution. The flora of the continent largely consists of bryophytes. There are about 100 species of mosses and 25 species of liverworts, but only three species of flowering plants, all of which are found in the Antarctic Peninsula: *Deschampsia antarctica* (Antarctic hair grass), *Colobanthus quitensis* (Antarctic pearlwort) and the non-native *Poa annua* (annual bluegrass).[159] Growth is restricted to a few weeks in the summer.[153][160]

Other organisms

Seven hundred species of algae exist, most of which are phytoplankton. Multicoloured snow algae and diatoms are especially abundant in the coastal regions during the summer.[160] Bacteria have been found living in the cold and dark as deep as 800 m (0.50 mi; 2,600 ft) under the ice.[161]

Conservation

The Protocol on Environmental Protection to the Antarctic Treaty (also known as the Environmental Protocol or Madrid Protocol) came into force in 1998, and is the main instrument concerned with conservation and management of biodiversity in Antarctica. The Antarctic Treaty Consultative Meeting is advised on environmental and conservation issues in Antarctica by the Committee for Environmental Protection. A major concern within this committee is the risk to Antarctica from unintentional introduction of non-native species from outside the region.[162]

The Southern Ocean Whale Sanctuary is an area of 50 million square kilometres around Antarctica where the International Whaling Commission has banned commercial whaling.

The passing of the Antarctic Conservation Act (1978) in the U.S. brought several restrictions to U.S. activity on Antarctica. The introduction of alien plants or animals can bring a criminal penalty, as can the extraction of any indigenous species. The overfishing of krill, which plays a large role in the Antarctic ecosystem, led officials to enact regulations on fishing. The Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR), a treaty that came into force in 1980, requires that regulations managing all Southern Ocean fisheries consider potential effects on the entire Antarctic ecosystem.[1] Despite these new acts, unregulated and illegal fishing, particularly of Patagonian toothfish (marketed as Chilean Sea Bass in the U.S.), remains a serious problem. The illegal fishing of toothfish has been increasing, with estimates of 32,000 tonnes (35,000 short tons) in 2000.[163][164]

Population

The "ceremonial" South Pole, at Amundsen–Scott Station

Several governments maintain permanent, staffed research stations on the continent. The number of people conducting and supporting scientific research and other work on the continent and its nearby islands varies from about 1,000 in winter to about 5,000 in the summer, giving it a population density between 70 and 350 inhabitants per million square kilometres (180 and 900 per million square miles) at these times. Many of the stations are staffed year-round, the winter-over personnel typically arriving from their home countries for a one-year assignment. An Orthodox church—Trinity Church, opened in 2004 at the Russian Bellingshausen Station—is manned year-round by one or two priests, who are similarly rotated every year.[165][166]

The first semi-permanent inhabitants of regions near Antarctica (areas situated south of the Antarctic Convergence) were British and American sealers who used to spend a year or more on South Georgia, from 1786 onward. During the whaling era, which lasted until 1966, the population of that island varied from over 1,000 in the summer (over 2,000 in some years) to some 200 in the winter. Most of the whalers were Norwegian, with an increasing proportion of Britons. The settlements included Grytviken, Leith Harbour, King Edward Point, Stromness, Husvik, Prince Olav Harbour, Ocean Harbour and Godthul. Managers and other senior officers of the whaling stations often lived together with their families. Among them was the founder of Grytviken, Captain Carl Anton Larsen, a prominent Norwegian whaler and explorer who, along with his family, adopted British citizenship in 1910.[167]

The first child born in the southern polar region was a Norwegian girl, Solveig Gunbjørg Jacobsen, born in Grytviken on 8 October 1913, and her birth was registered by the resident British Magistrate of South Georgia. She was a daughter of Fridthjof Jacobsen, the assistant manager of the whaling station, and Klara Olette Jacobsen. Jacobsen arrived on the island in 1904 and became the manager of Grytviken, serving from 1914 to 1921; two of his children were born on the island.[168]

Port Lockroy Museum

Emilio Marcos Palma was the first person born south of the 60th parallel south, the first born on the Antarctic mainland, and the only living human to be the first born on any continent.[169] He was born in 1978 at Esperanza Base, on the tip of the Antarctic Peninsula;[170][171] his parents were sent there along with seven other families by the Argentine government to determine if the continent was suitable for family life. In 1984, Juan Pablo Camacho was born at the Frei Montalva Station, becoming the first Chilean born in Antarctica. Several bases are now home to families with children attending schools at the station.[172] As of 2009, eleven children were born in Antarctica (south of the 60th parallel south): eight at the Argentine Esperanza Base[173] and three at the Chilean Frei Montalva Station.[174]

Politics

Several countries claim sovereignty in certain regions. While a few of these countries have mutually recognised each other's claims,[175] the validity of these claims is not recognised universally.[1]

New claims on Antarctica have been suspended since 1959, although in 2015 Norway formally defined Queen Maud Land as including the unclaimed area between it and the South Pole.[176] Antarctica's status is regulated by the 1959 Antarctic Treaty and other related agreements, collectively called the Antarctic Treaty System. Antarctica is defined as all land and ice shelves south of 60° S for the purposes of the Treaty System.

The treaty was signed by twelve countries including the Soviet Union (and later Russia), the United Kingdom, Argentina, Chile, Australia, and the United States.[177] It set aside Antarctica as a scientific preserve, established freedom of scientific investigation and environmental protection, and banned military activity on Antarctica. This was the first arms control agreement established during the Cold War.

Emblem of the Antarctic Treaty since 2002.

In 1983 the Antarctic Treaty Parties began negotiations on a convention to regulate mining in Antarctica.[178] A coalition of international organisations[179] launched a public pressure campaign to prevent any minerals development in the region, led largely by Greenpeace International,[180] which operated its own scientific station—World Park Base—in the Ross Sea region from 1987 until 1991[181] and conducted annual expeditions to document environmental effects of humans on Antarctica.[182] In 1988, the Convention on the Regulation of Antarctic Mineral Resources (CRAMRA) was adopted.[183] The following year, however, Australia and France announced that they would not ratify the convention, rendering it dead for all intents and purposes. They proposed instead that a comprehensive regime to protect the Antarctic environment be negotiated in its place.[184] The Protocol on Environmental Protection to the Antarctic Treaty (the "Madrid Protocol") was negotiated as other countries followed suit and on 14 January 1998 it entered into force.[184][185] The Madrid Protocol bans all mining in Antarctica, designating the continent as a "natural reserve devoted to peace and science".[186]

The Antarctic Treaty prohibits any military activity in Antarctica, including the establishment of military bases and fortifications, military manoeuvres, and weapons testing. Military personnel or equipment are permitted only for scientific research or other peaceful purposes.[187] The only documented military land manoeuvre has been the small Operation NINETY by the Argentine military in 1965.[188]

Antarctic territories

Date	Claimant	Territory	Claim limits	Map
1840	France	Adélie Land	142°02′E to 136°11′E	
1908	United Kingdom	British Antarctic Territory	080°00′W to 020°00′W including overlaps: ▪ 80°00′W to 74°00′W claimed by Chile (1940) ▪ 74°00′W to 53°00′W claimed by Chile (1940) and Argentina (1943) ▪ 53°00′W to 25°00′W claimed by Argentina (1943)	
1923	New Zealand	Ross Dependency	160°00′E to 150°00′W	
1931	Norway	Peter I Island	68°50′S 90°35′W	
1933	Australia	Australian Antarctic Territory	044°38′E to 136°11′E, and 142°02′E to 160°00′E	
1939	Norway	Queen Maud Land	020°00′W to 044°38′E	
1940	Chile	Chilean Antarctic Territory	090°00′W to 053°00′W including overlaps: ▪ 90°00′W to 74°00′W claimed by the United Kingdom (1908) ▪ 74°00′W to 53°00′W claimed by the United Kingdom (1908) and Argentina (1943)	
1943	Argentina	Argentine Antarctica	074°00′W to 025°00′W including overlaps: ▪ 74°00′W to 53°00′W claimed by the United Kingdom (1908) and Chile (1940) ▪ 53°00′W to 25°00′W claimed by the United Kingdom (1908)	
–	*(Unclaimed territory)*	Marie Byrd Land	150°00′W to 090°00′W (except Peter I Island)	

The Argentine, British and Chilean claims all overlap, and have caused friction. On 18 December 2012, the British Foreign and Commonwealth Office named a previously unnamed area Queen Elizabeth Land in tribute to Queen Elizabeth II's Diamond Jubilee.[189] On 22 December 2012, the UK ambassador to Argentina, John Freeman, was summoned to the Argentine government as a protest against the claim.[190] Argentine–UK relations had previously been damaged throughout 2012 due to disputes over the sovereignty of the nearby Falkland Islands, and the 30th anniversary of the Falklands War.[191]

The areas shown as Australia's and New Zealand's claims were British territory until they were handed over following the countries' independence. Australia currently claims the largest area. The claims of Britain, Australia, New Zealand, France and Norway are all recognised by each other.[192]

Other countries participating as members of the Antarctic Treaty have a territorial interest in Antarctica, but the provisions of the Treaty do not allow them to make their claims while it is in force.[193][194]

- Brazil has a designated "zone of interest" that is not an actual claim.[195]
- Peru has formally reserved its right to make a claim.[193][194]
- Russia has inherited the Soviet Union's right to claim territory under the original Antarctic Treaty.[196]
- South Africa has formally reserved its right to make a claim.[193][194]
- United States reserved its right to make a claim in the original Antarctic Treaty.[196]

Economy

There is no current economic activity in Antarctica outside of fishing off the coast and small-scale tourism.[1]

HMS *Endurance*: the Royal Navy's former Antarctic patrol ship

Although coal, hydrocarbons, iron ore, platinum, copper, chromium, nickel, gold and other minerals have been found, they have not been in large enough quantities to exploit.[197] The 1991 Protocol on Environmental Protection to the Antarctic Treaty also restricts a struggle for resources. In 1998, a compromise agreement was reached to place an indefinite ban on mining, to be reviewed in 2048, further limiting economic development and exploitation. The primary economic activity is the capture and offshore trading of fish. Antarctic fisheries in 2000–01 reported landing 112,934 tonnes.[198]

Post office Tangra 1091 Antarctic postal services of the Bulgarian scientific station

Small-scale "expedition tourism" has existed since 1957 and is currently subject to Antarctic Treaty and Environmental Protocol provisions, but in effect self-regulated by the International Association of Antarctica Tour Operators (IAATO). Not all vessels associated with Antarctic tourism are members of IAATO, but IAATO members account for 95% of the tourist activity. Travel is largely by small or medium ship, focusing on specific scenic locations with accessible concentrations of iconic wildlife. A total of 37,506 tourists visited during the 2006–07 Austral summer with nearly all of them coming from commercial ships; 38,478 were recorded in 2015–16.[199][200][201] As of 2015, there are two Wells Fargo ATMs in Antarctica, both located at McMurdo Station.[202]

There has been some concern over the potential adverse environmental and ecosystem effects caused by the influx of visitors. Some environmentalists and scientists have made a call for stricter regulations for ships and a tourism quota.[203] The primary response by Antarctic Treaty Parties has been to develop, through their Committee for Environmental Protection and in partnership with IAATO, "site use guidelines" setting landing limits and closed or restricted zones on the more frequently visited sites. Antarctic sightseeing flights (which did not land) operated out of Australia and New Zealand until the fatal crash of Air New Zealand Flight 901 in the Mount Erebus disaster in 1979, which killed all 257 people aboard.[204] Qantas resumed commercial overflights to Antarctica from Australia in the mid-1990s.[205]

About thirty countries maintain about seventy research stations (40-year-round or permanent, and 30 summer-only) in Antarctica, with an approximate population of 4000 in summer and 1000 in winter.[1]

The ISO 3166-1 alpha-2 "AQ" is assigned to the entire continent regardless of jurisdiction. Different country calling codes and currencies[206] are used for different settlements, depending on the administrating country. The Antarctican dollar, a souvenir item sold in the United States and Canada, is not legal tender.[1][207]

Research

29 national programmes supporting science in Antarctica (2009)

Each year, scientists from 28 nations conduct experiments not reproducible in any other place in the world. In the summer more than 4,000 scientists operate research stations; this number decreases to just over 1,000 in the winter.[1] McMurdo Station, which is the largest research station in Antarctica, is capable of housing more than 1,000 scientists, visitors, and tourists.[208]

Researchers include biologists, geologists, oceanographers, physicists, astronomers, glaciologists, and meteorologists. Geologists tend to study plate tectonics, meteorites from outer space, and resources from the breakup of the supercontinent Gondwana. Glaciologists in Antarctica are concerned with the study of the history and dynamics of floating ice, seasonal snow, glaciers, and ice sheets. Biologists, in addition to examining the wildlife, are interested in how harsh temperatures and the presence of people affect adaptation and survival strategies in a wide variety of organisms.[209] Medical physicians have made discoveries concerning the spreading of viruses and the body's response to extreme seasonal temperatures.[210]

Since the 1970s an important focus of study has been the ozone layer in the atmosphere above Antarctica. In 1985, three British scientists working on data they had gathered at Halley Station on the Brunt Ice Shelf discovered the existence of a hole in this layer. It was eventually determined that the destruction of the ozone was caused by chlorofluorocarbons (CFCs) emitted by human products.[211] With the ban of CFCs in the Montreal Protocol of 1989, climate projections indicate that the ozone layer will return to 1980 levels between 2050 and 2070.[212]

In 2007, The Polar Geospatial Center was founded. The Polar Geospatial Center uses geospatial and remote sensing technology to provide mapping services to American federally funded research teams. Currently, the Polar Geospatial Center can image all of Antarctica at 500 mm (20 in) resolution every 45 days.[213] In 2007 the Belgian-based International Polar Foundation unveiled the Princess Elisabeth station, the world's first zero-emissions polar science station in Antarctica, to research climate change. The prefabricated station, which is part of the International Polar Year, was shipped to the South Pole from Belgium by the end of 2008 to monitor the health of the polar regions. The project includes research in climatology, glaciology and microbiology.[214]

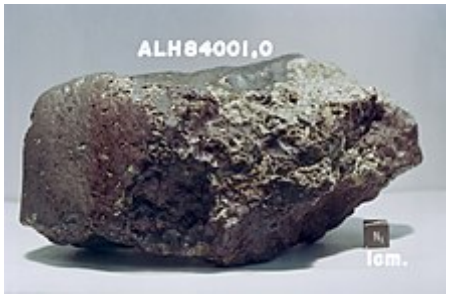
Astrophysics

A full moon allowed sufficient light for this photo at Amundsen–Scott South Pole Station. The station can be seen at far left, the power plant in the centre and the mechanic's garage in the lower right. The green light in the background is the aurora australis.

Astrophysicists at Amundsen–Scott South Pole Station study the celestial dome and cosmic microwave background radiation. Many astronomical observations are better made from the interior of Antarctica than from most surface locations because of the high elevation, which results in a thin atmosphere; low temperature, which minimises the amount of water vapour in the atmosphere; and absence of light pollution, thus allowing for a view of space clearer than anywhere else on Earth. Antarctic ice serves as both the shield and the detection medium for the largest neutrino telescope in the world, the IceCube Neutrino Observatory built 2 km (1.2 mi) below Amundsen–Scott station.[215]

Meteorites from Antarctica are an important area of study of material formed early in the solar system; most are thought to come from asteroids, but some may have originated on larger planets. The first meteorite was found in 1912 and named the Adelie Land meteorite. In 1969, a Japanese expedition discovered nine meteorites. Most of these meteorites have fallen onto the ice sheet in the last million years. The motion of the ice sheet tends to concentrate the meteorites at blocking locations such as mountain ranges, with wind erosion bringing them to the surface after centuries beneath accumulated snowfall. Compared with meteorites collected in more temperate regions on Earth, the Antarctic meteorites are well-preserved.[216]

This large collection of meteorites allows a better understanding of the abundance of meteorite types in the solar system and how meteorites relate to asteroids and comets. New types of meteorites and rare meteorites have been found. Among these are pieces blasted off the Moon and Mars by impacts. These specimens, particularly ALH84001 discovered by ANSMET, were at the centre of the controversy about possible evidence of microbial life on Mars. Because meteorites in space absorb and record cosmic radiation, the time elapsed since the meteorite hit the Earth can be determined from laboratory studies. The elapsed time since fall, or terrestrial residence age, of a meteorite represents more information that might be useful in environmental studies of Antarctic ice sheets.[216]



Antarctic meteorite, named ALH84001, from Mars

Notes

1. The word was originally pronounced with the first *c* silent in English, but the spelling pronunciation has become common and is often considered more correct. The pronunciation with a silent *c*, and even with the first *t* silent as well, is however widespread and typical of many similar English words.[2] The *c* had ceased to be pronounced in Medieval Latin and was dropped from the spelling in Old French, but it was added back for etymological reasons in English in the 17th century and thereafter began to be pronounced, but (as with other spelling pronunciations) at first only by less educated people.[3][4] For those who pronounce the first *t*, there is also variation between the pronunciations *Ant-ar(c)tica* and *An-tar(c)tica*.

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