

Antarctica – A Continent of Superlatives

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Polar regions of the Earth have been the focus of scientific researches on climate change, geology, ocean observations, electric and magnetic flux measurements, and environmental monitoring. Thus, basic understanding and recent developments in these areas become critical from UPSC point of view.

In news: India launched its 40th scientific expedition to Antarctica.

Placing it in syllabus: Science and technology

Dimensions

1. General Features of the continent
2. Differences between Arctic and Antarctica
3. Impact of climate change on Arctic and Antarctica
4. Indian missions and expeditions to Antarctica

Content:

General Features of Antarctica:

- Antarctica is a continent in the Southern hemisphere. Its landmass is covered almost entirely by ice.
- Antarctica is the world's southernmost continent. It is the fifth-largest continent by area – after Asia, Africa, North America, and South America.
- It is also the world's highest, driest, windiest, coldest, and iciest continent.

Position:

- It lies concentrically around the South Pole. It is **almost entirely south of the Antarctic Circle**

(6612degree South latitude).

- Antarctica is about 14.2 million square km in size, and thick ice covers about 98 percent of the land.
- The continent is divided into **East Antarctica** (which is largely composed of a high ice-covered plateau) and **West Antarctica** (which is largely an ice sheet covering an archipelago of mountainous islands).
- East and West Antarctica are separated by the approximately 3,400-km long **Transantarctic Mountains**.
- The southernmost parts of the Atlantic, Pacific and Indian oceans converge into a cold oceanic water mass with unique biological and physical characteristics. This zone is known as **Antarctic Convergence**.

Human settlements:

- **Humans do not live in Antarctica permanently**. But, around 1,000 to 5,000 people live temporarily at the science stations.
- Tourists visit Antarctica in the summers (November – February in the Southern Hemisphere)

Flora and Fauna:

- The animals include penguins, seals, nematodes, tardigrades and mites. Plant life includes some grass and shrubs, algae, lichen, fungi, and bacteria.

Climate:

- Antarctica is a **cold dry desert**. It has yearly **precipitation of only 200 mm** (8 inches) near the sea and far less inland.

The Antarctic Treaty System:

- The Antarctic Treaty System is the whole complex of arrangements made for the purpose of regulating relations among states in the Antarctic.
- The Antarctic Treaty was signed in Washington on 1

December 1959 by the 12 countries whose scientists had been active in and around Antarctica.

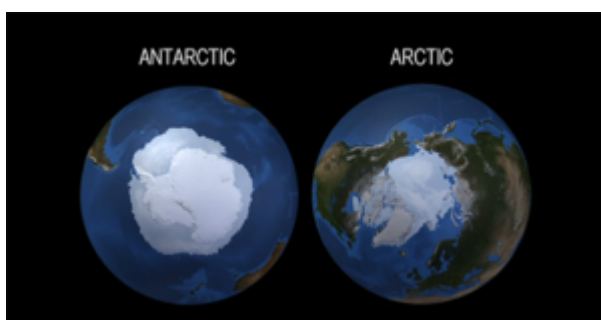
- It entered into force in 1961 and has since been acceded to by many other nations.
- The total number of Parties to the Treaty is now 54.
- India became a member of this treaty in 1983.
- As per the Treaty, Antarctica is defined as all of the land and ice shelves south of 60°S latitude.

Some important provisions of the treaty:

- Antarctica shall be used for peaceful purposes only
- Freedom of scientific investigation in Antarctica and cooperation toward that end shall continue
- Scientific observations and results from Antarctica shall be exchanged and made freely available

Differences between Arctic and Antarctica:

Both Arctic and Antarctica are covered by ice – so they appear similar in most respects. But they are fundamentally very different.



Major Geographical Difference:

- The biggest difference is that the **Arctic is sea surrounded by land** while the **Antarctic is land surrounded by sea** .
- The Arctic is an ocean, covered by a thin layer of perennial sea ice and surrounded by land.
- Antarctica is a continent, covered by a very thick ice

cap and surrounded by a rim of sea ice and the Southern Ocean.

Topography:

- If you stand at the North Pole sea level is usually no more than 1m below your feet and the sea bed another 4,260m below that. So, the Arctic region is more or less **at the mean sea level**.
- But, at the South Pole the altitude is about 2,835m on ice that is 2,700m thick. People arriving at the South pole by plane experience **altitude sickness**.

Ice Cover:

- The Arctic region is covered with ice which is made of **frozen sea water** with some snow on top. It contains a large proportion of multi year sea-ice that is 3-4m thick with some much thicker ridges. The ice may be flat and smooth or rough, having been **broken up and refrozen** together again.
- On the Antarctic, the ice is made from **fresh water and snow**. The ice is made from accumulated snowfall that has built up because it never melts. In the winter, the Southern Ocean around the Antarctic continent also becomes covered with sea ice. But every summer most of this sea ice melts.

Climate:

The Arctic is not as cold as the Antarctic region. This is because of three reasons.

1. *Effect of the sea:* Sea temperature doesn't fall below -2°C which means that the whole of the arctic polar region and coastal regions are kept relatively warm even though the sea is covered by ice.
2. *Altitude:* Antarctica is the highest of all the continents at an average height of 2,300m (7,546 feet or

1.4 miles) more than twice the average height of Asia, the next in line and 3-6 times as high as the other continents. Temperature falls as altitude increases at the rate of about 1°C per 100m.

3. *Circumpolar winds and currents at the Antarctica*: drive the weather in Antarctica round and round the continent. In contrast, the weather in the Arctic spills out to the south and weather from the south spills into the arctic.

Animals:

- **The Arctic has many large land animals** including reindeer, musk ox, lemmings, arctic hares, arctic terns, snowy owls, squirrels, arctic fox and polar bears.
- As the Arctic is a part of the land masses of Europe, North America and Asia, these animals can migrate south in the winter and head back to the north again in the more productive summer months.
- The **largest land animal in Antarctica is an insect**, a wingless midge, *Belgica antarctica*, less than 1.3cm (0.5in) long. There are no flying insects.
- There are however a great many animals that feed in the sea though come onto the land for part or most of their lives, these include huge numbers of adelic, chinstrap, gentoo, king, emperor, rockhopper and macaroni penguins.

Human Inhabitants:

- There are **many indigenous peoples who live around the Arctic**. There are representatives of many different groups such as the Inuit, Chukchi, Sami, Yupik, Inupiat and others. Typically the people who live in the far north are nomadic and are hunter/gatherers with the emphasis on hunting rather than gathering
- Antarctica has **never had any native people** living there. Antarctica has only ever been habited by scientific stations and their personnel who only stay for a year or

two.

Antarctica has some important features hidden by the ice.

Lake Vostok:

- It has been covered by ice for at least 15 million years. The lake is 250 km long and 50 km wide. It is the largest of Antarctica's almost 400 known subglacial lakes.

Gamburtsev mountain chain:

- These are the size of the Alps, yet entirely buried under the ice.
- The Gamburtsev range has a nearby massive rift valley similar to the East African Great Rift Valley. It is called the Lambert system.

Scientists used radar that can work under ice to survey the whole of Antarctica.

Impact of climate change on Arctic and Antarctica:

Scientific research has shown that climate change is already negatively impacting the Arctic and Antarctica. The poles of the Earth are more sensitive to any change in the planet's climate than the rest of the planet. In the face of ongoing global warming, the poles are warming faster than lower latitudes. The primary cause of this phenomenon is ice-albedo feedback where, by melting, ice uncovers darker land or ocean beneath, which then absorbs more sunlight, causing more heating.

Decline of sea ice:

- Sea ice is currently in decline in area, extent, and volume and summertime sea ice may cease to exist sometime during the 21st century.

Permafrost thaw:

- Higher temperatures cause permafrost thawing in the polar regions. The thawing of the various types of permafrost could release large amounts of carbon into the atmosphere. In the permafrost there is twice as much carbon as in the atmosphere.
- In 2019, a report called **"Arctic report card"** estimated the current greenhouse gas emissions from Arctic permafrost as almost equal to the emissions of Russia or Japan or less than 10% of the global emissions from fossil fuels.

Effect on ocean circulation:

- There is also a possibility of a more general disruption of ocean circulation, which may lead to an ocean anoxic event.
- Oceanic anoxic events or anoxic events are periods wherein large expanses of Earth's oceans were depleted of dissolved oxygen (O₂), creating toxic waters.

Threat to Biodiversity:

- The polar waters are bound to grow warmer because of climate change, which consequently raises the possibility that animal and plant species from warmer areas will move to the polar region.
- The less severe winters in tundra areas allow shrubs such as alders and dwarf birch to replace moss and lichens.

Territorial Claims:

- Growing evidence that global warming is shrinking polar ice has added to the urgency of several nations' Arctic territorial claims in hopes of establishing resource development and new shipping lanes, in addition to protecting sovereign rights.

- At the Arctic Ocean Conference, Foreign Ministers and other officials representing the five countries (Greenland, Canada, Norway, Russia and the United States) announced the Ilulissat Declaration on 28 May 2008.

Indian missions and expeditions to Antarctica:

- The Indian Antarctic expeditions began in 1981. The first trip consisted of a team of 21 scientists and support staff led by Dr SZ Qasim.
- This marked the start of India's Southern Ocean expeditions under the environmental protocol of the Antarctic Treaty (1959).
- After a humble beginning, the Indian Antarctic programme has now been credited to have built three permanent research base stations in Antarctica named **Dakshin Gangotri, Maitri, and Bharati**.
- **Dakshin Gangotri:** The first permanent settlement was built in 1983 and named Dakshin Gangotri.
- **Maitri:** The second permanent settlement, Maitri, was put up in 1989 on the Schirmacher Oasis and has been conducting experiments in geology, geography and medicine. India built this station close to a freshwater lake around Maitri known as Lake Priyadarshini. Maitri accomplished the mission of geomorphologic mapping of Schirmacher Oasis.
- **Bharati:** It was established in 2015. It is located beside Larsmann Hill. This newest research station for oceanographic research. It will collect evidence of continental breakup to reveal the 120-million-year-old ancient history of the Indian subcontinent.
- As of today, India has two operational research stations in Antarctica named Maitri and Bharati. The **National Centre for Polar and Ocean Research (NCPOR), Goa, manages the entire Indian Antarctic program**.
- The **40th Indian Scientific Expedition to Antarctica**

(ISEA) departed for the South Pole from Mormugao Port, Goa with 43 members on board, January 5, 2021.

- Cautious steps have been taken to avoid contraction and spread of the novel coronavirus disease (COVID-19) on board the expedition vessel and the virus reaching Antarctica.

Mould your thought:

1. The Arctic and Antarctica are literally polar opposites. Elaborate.

Approach to the answer:

- Introduction
- Write about how both look similar from a bird's eye view.
- Enumerate the differences
- Conclude that they are really dissimilar