# RV Polarstern mission- impact of climate change on Arctic

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**Manifest pedagogy**

Issues of global warming and its impact on Arctic region have been asked earlier. The utility of scientific studies, consequences of ice melt, geopolitical race for Arctic region and reasons for it etc are some other dimensions which could be asked both at the prelims and mains stage

**In news**

- Scientists from 17 nations will take part in the year-long mission in German RV Polarstern ship in Arctic sea ice to study climate change

**Placing it in syllabus**

- Location changes in critical geographical features and environmental issues

**Static dimensions**

- What is cryosphere?

**Current dimensions**

- Impact of global warming on cryosphere
- Causes and consequences of Arctic melting
- Missions/scientific study for melting of Arctic and analysing reasons and rate of melting

**Content**

The Arctic is under great threat from a multitude of environmental changes induced by human activities, most

importantly through climate change, but also through pollution, industrial fishing, foreign species introduced to the area, nuclear waste and petroleum activity. Climate change is probably the process that will cause the single greatest impact in the Arctic in the coming years. For example, a global temperature change of one degree translates to a threefold temperature increase in the Arctic. This implies that, without cuts in global CO2 emissions, the Barents Sea will be ice free by 2050.

When most people think of ice melting at the North and South poles, they automatically think of sea levels rising. But the melting of the ice sheets – and lower ice extents during the winter months – means much more than just additional water in the oceans, as the lack of ice at the poles also changes the ocean's water currents, the jet streams and how weather forms across the planet. How fast polar ice disappears depends upon the world's effectiveness at reducing pollution. Without effective programs in place to regulate, reduce and eliminate greenhouse gases – carbon dioxide, water vapour, methane, nitrous oxide and ozone – oceans across the globe may change more than just sea level

**What is cryosphere?**

There are places on Earth where the water is frozen solid. These areas of snow or ice, which are subject to temperatures below 32°F for at least part of the year, compose the cryosphere

The term "cryosphere" comes from the Greek word, "krios," which means cold. Ice and snow on land form the largest parts of the cryosphere. The continental ice sheets found in Greenland and Antarctica, as well as ice caps, glaciers, and areas of snow and the permafrost ( soils of polar regions filled with frozen water), frozen rivers and lakes mainly occuring in polar areas, all constitute cryosphere. Approximately three-quarters of the world's fresh water is

frozen in the cryosphere

The components of the cryosphere play an important role in the Earth’s climate. As polar regions are most sensitive to climate shifts, the cryosphere may be one of the first places where scientists are able to identify global changes in climate

**Impact of global warming on cryosphere**

Anthropogenic warming will shrink the cryosphere, increasing the absorbed radiation and surface heating, primarily at high latitudes resulting in sea level rises. Many scientific studies have been focused on the impacts that global warming may have on natural systems in the Arctic. The results suggest that major environmental impacts will include changes in the distribution and thinning of the sea ice, lengthening of the snow-free period, changes of the temperature, distribution, and depth of seasonal thawing of permafrost, and changes in the plant cover and biodiversity. Such changes in the natural systems will interfere with the human environment and have direct and immediate implications on land use, the economy and human life in the Arctic

- Climate models predict that summer sea ice in the Arctic could shrink by 60% under conditions of CO2 doubling, opening new sea routes for northern navigation, fisheries, and ecotourism.
- With more open water, there will be a moderation of temperatures and increase in precipitation in Arctic lands.
- Lengthening of the ice- free period is likely to cause increased coastal erosion through wave action in the Nordic seas.
- In the Antarctica, changes will be less pronounced due to the severe cold climate, however, sea ice volume is predicted to decrease by 25% with its boundary retreating about two degrees latitude.

- Projected retreat of ice shelves on the Antarctic Peninsula will expose more bare ground, which may cause changes in terrestrial biology through introduction of exotic plants and animals.
- Reduction of the near-surface permafrost area and deeper summer thawing increase water storage capacity of the ground.

- **Global warming is causing soils in the polar regions that have been frozen for as much as 40,000 years to thaw. As they thaw, carbon trapped within the soils is released into the atmosphere as methane, a powerful greenhouse gas. The methane released to the atmosphere causes more global warming, which then melts more of the frozen soils. This is called "feedback effect"**

**Consequences of Arctic melting**

The cryosphere is an important part of the Earth system and it is so much interconnected with other parts of the system that changes in it affects other parts of the earth as well. Scientists are currently studying how the cryosphere has been affecting climate change through interactions with other parts of the Earth system

**Missions/scientific study for melting of Arctic and analysing reasons and rate of melting**

Today, scientists are studying the Arctic to learn more about how climate and weather are changing and how climate change will affect the region. To study the Arctic, researchers travel to the field to conduct experiments or make observations. They study the properties of snow and sea ice,

digging snow pits to examine the properties of snow, or measuring the thickness of sea ice by hand to determine how the ice cover is changing. Researchers also study the frozen ground and permafrost that covers much of the Arctic lands. And biologists research the unique plants and animals that live in the Arctic.

The Arctic is a huge region, and scientists cannot conceivably measure every bit of it in person. So researchers also use other tools to study the Arctic from afar. They make observations using remote sensing, a variety of tools that allow them to measure factors that they cannot see directly, or which are too big to observe in person. Instead, they mount sensors on airplanes or satellites to record data. For example, satellite data provides estimates of the sea ice cover on the Arctic Ocean as well as weather patterns over the Arctic. And scientists from NASA recently flew a series of missions over the Arctic during the **IceBridge project**, to study details of Arctic sea ice thickness as well as changing glaciers in Greenland.

Now the scientists are ready for a new expedition with German icebreaker **RV Polarstern.** Scientists plan to sail the ship into the Arctic Ocean, anchor it to a large piece of sea ice and allow the water to freeze around them, effectively trapping themselves in the vast sheet of white that forms over the North Pole each winter. Scientists from United States, China, Russia and other countries will be rotating every two months as other icebreakers bring fresh supplies.

By combining measurements on the ice with data collected from satellites, scientists hope to improve the increasingly sophisticated computer models for weather and climate predictions. The mission has received funding from U.S. institutions such as the National Science Foundation, the Department of Energy, the National Oceanic and Atmospheric Administration, and NASA.

The ship has a fully equipped medical station to avoid any calamity on board. The **MOSAiC mission, which stands for Multidisciplinary drifting Observatory for the Study of Arctic Climate**, comes about 125 years after Norwegian explorer Fridtjof Nansen first managed to seal his wooden expedition ship, Fram, into the ice during a three-year expedition to the North Pole