



Arctic Sea Ice Melting

For Prelims: [Arctic Amplification](#), [Intergovernmental Panel on Climate Change \(IPCC\)](#), [IndARC](#), **Albedo**, [Polar Jet Streams](#)

For Mains: Causes of Arctic Warming, melting of Arctic Sea Ice, Its impact on India

Why in News?

A recent study in the Nature journal suggests that the melting of Arctic Sea ice in summer is inevitable in the coming decades.

- The **loss of Arctic Sea ice due to global warming (arctic amplification)** has raised concerns about its impact on global climate and the environment.

What are the New Findings on Arctic Sea Ice?

- **Sea Ice Decline:**
 - [Intergovernmental Panel on Climate Change \(IPCC\)](#) reports **confirm the decline** of Arctic Sea ice.
 - The first "**sea-ice free summer**" is projected to occur before **2050**, due to global emissions **driving temperatures beyond 4.5°C**.
 - Satellite records indicate a yearly rate of **Arctic ice loss at nearly 13%**.
- **Insufficient Emission Reductions:**
 - The Nature study indicates that **no emission scenario can prevent the loss of Arctic Sea ice** in summer.
 - If significant emission **reductions are not undertaken**, an **ice-free summer** could occur **as early as the 2030s**.
- **Underestimated Melting Rate:**
 - **Human-induced factors contribute to approximately 90%** of ice melting, while natural variability accounts for the rest.
 - **Climate models**, including those used by the IPCC, **underestimated the speed of melting**.
 - Correcting for this underestimation reveals the possibility of **ice-free Augusts and Octobers by 2080**.

What is the Importance of Arctic Sea Ice?

- **Climate Influence:**
 - Arctic sea ice **plays a crucial role in influencing global climate patterns**.
 - It **reflects sunlight**, helping to **maintain the earth's energy balance** and **cool polar regions**.
 - Sea ice **acts as a barrier**, keeping the **air cool by separating cold air** above from **warmer water below**.
- **Biodiversity and Indigenous Communities:**

- Changes in sea ice **impact biodiversity**, particularly **mammals like polar bears and walruses**.
- **Indigenous Arctic populations** **reliant on sea ice for hunting, breeding, and migration are affected**.
- **Economic Opportunities and Competition:**
 - Reduced ice cover **opens shipping lanes and facilitates access to natural resources** in the Arctic.
 - This **leads to increased competition among countries for influence** and resource exploitation in the region.

What is Arctic Amplification?

- **About:**
 - [Arctic amplification](#) refers to the phenomenon where changes in surface air temperature and net radiation balance produce larger effects at the poles, specifically in the **Arctic region**.
- **Causes:**
 - It is a **result of global warming caused by anthropogenic forces** or human activities since pre-industrial times, **leading to a 1.1-degree Celsius increase** in the Earth's average temperature.
 - The **primary causes** of Arctic amplification include **ice-albedo feedback, lapse rate feedback, water vapor feedback, and ocean heat transport**.
 - **Diminishing sea ice in the Arctic** due to global warming **plays a significant role** in amplifying the warming effect.
 - **Sea ice and snow have high albedo**, reflecting most solar radiation, **while water and land absorb more radiation**, leading to **increased warming**.
 - The **reduction of sea ice allows the Arctic Ocean to absorb more solar radiation**, further amplifying the warming effect.
 - The **lapse rate, which is the rate at which temperature decreases with elevation**, decreases with warming, contributing to Arctic amplification.
 - **Studies suggest that the ice-albedo feedback and lapse rate feedback account for 40% and 15% of polar amplification, respectively**.
- **Consequences:**
 - **Weakening of [Polar Jet Streams](#):**
 - **Diminished sea ice weakens polar jet streams**, resulting in **rising temperatures and heatwaves in Europe**.
 - **Unseasonal showers in northwest India** have also been linked to this weakening.
 - **Melting of Ice:**
 - The Greenland ice sheet's melting contributes to rising sea levels, with a complete melt potentially causing a seven-meter rise.
 - **Changes in Composition of Sea Water:**
 - Warming of the Arctic Ocean and seas, along with changes in salinity and acidification, affects biodiversity, including marine and dependent species.
 - **Affects Fauna:**
 - Increased rainfall due to Arctic amplification affects the availability and accessibility of lichens, leading to starvation and death among Arctic fauna.
 - **Gaseous Emission:**
 - Thawing **permafrost releases carbon and methane, greenhouse gases** responsible for global warming.
 - It may **also release long-dormant bacteria and viruses**, potentially leading to disease outbreaks.

What is Impact on India?

- **Extreme Rainfall Events:**
 - Studies found that the reduced sea ice in the Barents-Kara Sea region can lead to extreme rainfall events in the latter half of the monsoons — in September and October in India.
- **Warming of Arabian Sea:**

- The changes in the atmospheric circulation due to diminishing sea ice combined with the warm temperatures in the Arabian Sea contribute to enhanced moisture and drive extreme rainfall events.
 - In 2014, **India deployed [IndARC](#)**, India's first moored-**underwater observatory in the Kongsfjorden fjord, Svalbard**, to monitor the impact of the changes in the Arctic Ocean.
- **Rise in Sea Level along Indian Coast:**
 - According to the 'State of Global Climate in 2021' report, sea level along the Indian coast is rising faster than the global average rate.



UPSC Civil Services Examination, Previous Year Question (PYQ)

Prelims

Q. Which of the following statements is/are correct about the deposits of 'methane hydrate'? (2019)

1. Global warming might trigger the release of methane gas from these deposits.
2. Large deposits of 'methane hydrate' are found in Arctic Tundra and under the sea floor.
3. Methane in atmosphere oxidizes to carbon dioxide after a decade or two.

Select the correct answer using the code given below.

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

Ans: (d)

Exp:

- Methane hydrate is a crystalline solid that consists of a methane molecule surrounded by a cage of interlocking water molecules. It is an “ice” that only occurs naturally in subsurface deposits where temperature and pressure conditions are favourable for its formation.
- Regions with suitable temperature and pressure conditions for the formation and stability of methane hydrate- sediment and sedimentary rock units below the Arctic permafrost; sedimentary deposits along continental margins; deep-water sediments of inland lakes and seas; and, under Antarctic ice. Hence, statement 2 is correct.
- Methane hydrates, the sensitive sediments, can rapidly dissociate with an increase in temperature or a decrease in pressure. The dissociation produces free methane and water, which can be triggered by global warming. Hence, statement 1 is correct.
- Methane is removed from the atmosphere in about 9 to 12-year period by oxidation reaction where it is converted into Carbon Dioxide. Hence, statement 3 is correct.
- **Therefore, option (d) is the correct answer.**

Mains:

Q. How do the melting of the Arctic ice and glaciers of the Antarctic differently affect the weather patterns and human activities on the Earth? Explain **(2021)**

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