Arctic Ocean: Ice-free in summer by 2030s

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Why in News: The Arctic Ocean could be ice-free in summer by the 2030s, even if we do a good job of reducing emissions between now and then. That's the worrying conclusion of a new study in Nature Communications.

Background

The Arctic has been experiencing climate heating faster than any other part of the planet. As it is at the frontline of climate change, the eyes of many scientists and local indigenous people have been on the sea ice that covers much of the Arctic Ocean in winter.

This thin film of frozen seawater expands and contracts with the seasons, reaching a minimum area in September each year

The disappearance of sea ice at the top of the world would not only be an emblematic sign of climate breakdown, but it would have global, damaging and dangerous consequences

Predictions of an ice-free Arctic Ocean have a long and complicated history, and the 2030s is sooner than most scientists had thought possible

One problem with predicting when this might occur is that sea ice is notoriously difficult to model because it is influenced by both atmospheric and oceanic circulation as well as the flow of heat between these two parts of the climate system. That means that the climate models – powerful computer programs used to simulate the environment – need to get all of these components right to be able to accurately predict changes in sea ice extent.

Multiyear Sea Ice and Blue Ocean Event

The ice which remains at the end of summer is called multiyear sea ice and is considerably thicker than its seasonal counterpart.

It acts as barrier to the transfer of both moisture and heat between the ocean and atmosphere. Over the past 40 years this multiyear sea ice has shrunk from around 7 million sq. km to 4 million.

That is a loss equivalent to roughly the size of India or 12 UKs. In other words, it's a big signal, one of the most stark and dramatic signs of fundamental change to the climate system anywhere in the world.

As a consequence, there has been considerable effort invested in determining when the Arctic Ocean might first become ice-free in summer, sometimes called a "blue ocean event" and defined as when the sea ice area drops below 1 million sq. km.

This threshold is used mainly because older, thicker ice along parts of Canada and northern Greenland is expected to remain long after the rest of the Arctic Ocean is ice-free.

We can't put an exact date on the last blue ocean event, but one in the near future would likely mean open water at the North Pole for the first time in thousands of years.

Melting faster than models predicted

Back in the 2000s, an assessment of early generations of climate models found they generally underpredicted the loss of sea ice when compared to satellite data showing what actually happened. The models predicted a loss of about 2.5% per decade, while the observations were closer to 8%.

The next generation of models did better but were still not matching observations which, at that time were suggesting a blue ocean event would happen by mid-century.

Indeed, the latest IPCC climate science report, published in 2021, reaches a similar conclusion about the timing of an ice-free Arctic Ocean.

As a consequence of the problems with the climate models, some scientists have attempted to extrapolate the observational record resulting in the controversial and, ultimately, incorrect assertion that this would happen during the mid 2010s. This did not help the credibility of the scientific community and its ability to make reliable projections.

Subjectivity of the Recent report

The scientists behind the latest study have taken a different approach by, in effect, calibrating the models with the observations and then using this calibrated solution to project sea ice decline.

This makes a lot of sense, because it reduces the effect of small biases in the climate models that can in turn bias the sea ice projections.

They call these “observationally constrained” projections and find that the Arctic could become ice-free in summer as early as 2030, even if we do a good job of reducing emissions between now and then.

There is still plenty of uncertainty around the exact date – about 20 years or so – because of natural chaotic fluctuations in the climate system. But compared to previous research, the new study still brings forward the most likely timing of a blue ocean event by about a decade.

Concerns with Arctic Sea Melt

Arctic sea ice is an important component of the climate system. As it dramatically reduces the amount of sunlight absorbed by the ocean, removing this ice is predicted to further accelerate warming, through a process known as positive feedback.

This, in turn, will make the Greenland ice sheet melt faster, which is already a major contributor to sea level rise.

The loss of sea ice in summer would also mean changes in atmospheric circulation and storm tracks, and fundamental shifts in ocean biological activity.

The warming of the Arctic Ocean and the seas in the region, the acidification of water, changes in the salinity levels, is impacting the biodiversity, including the marine species and the dependent species.

The warming is also increasing the incidence of rainfall which is affecting the availability and accessibility of lichens to the reindeer. The Arctic amplification is causing widespread starvation and death among the Arctic fauna.

The permafrost in the Arctic is thawing and in turn releasing carbon and methane which are among the major greenhouse gases responsible for global warming.

Experts fear that the thaw and the melt will also release the long-dormant bacteria and viruses that were trapped in the permafrost and can potentially give rise to diseases. The best-known example of this is the permafrost thaw leading to an anthrax outbreak in Siberia in 2016, where nearly 2,00,000 reindeer succumbed.

Impact on India

In recent years, scientists have pondered over the impact the changing Arctic can have on the monsoons in the subcontinent. The link between the two is growing in importance due to the extreme weather events the country faces, and the heavy reliance on rainfall for water and food security.

A study titled ‘A possible relation between Arctic sea ice and late season Indian Summer Monsoon Rainfall extremes’ published in 2021 by a group of Indian and Norwegian scientists 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.

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 on the tropical processes such as the monsoons.