

Arctic Ocean could be ice-free for part of the year as soon as 2044

November 15 2019, by Katharine Reich



The fate of Arctic sea ice is a key topic for climate scientists because of its role in temperatures around the rest of the world. Credit: NASA

It's hard to imagine the Arctic without sea ice.

But according to a new study by UCLA [climate](#) scientists, human-caused climate change is on track to make the Arctic Ocean functionally ice-free for part of each year starting sometime between 2044 and 2067.

As long as humans have been on Earth, the planet has had a large cap of sea ice at the Arctic Circle that expands each winter and contracts each summer. The knowledge that sea ice is on the decline is not new: Satellite observations show that since 1979, the amount of sea ice in the Arctic in September—the month when there is the least sea ice, before water starts freezing again—has declined by 13 percent per decade.

Scientists have been attempting to predict the future of Arctic sea ice for several decades, relying on an array of global climate models that simulate how the climate system will react to all of the carbon dioxide entering the atmosphere. But the models' predictions have disagreed widely. Among the current generation of models, some show ice-free Septembers as early as 2026; others suggest the phenomenon will begin as late as 2132.

The UCLA study, which was published in *Nature Climate Change*, focuses the predictions to a 25-year period.

A Swiftly Melting Planet

Sea ice is a critical part of the Arctic ecosystem — and it plays a role in the global climate system. Global climate models project that Arctic summers will eventually become practically ice-free, but they disagree on when that will happen. In a new study published in *Nature Climate Change*, UCLA Center for Climate Science researchers have developed a novel way to evaluate how well different models depict sea ice processes — and to identify which models offer more realistic projections.

What is happening to Arctic sea ice?

The Arctic is already losing ice because of human-caused climate change. This image compares sea ice extent in 2019 (for the month of September, when Arctic sea ice is at its minimum) with the corresponding average between 1981 and 2010.



↑ **2x**

The Arctic is warming twice as rapidly, compared with the rest of the planet.

↓ **13%**

of Arctic sea ice has been lost each decade since 1979, satellite records show.

Why is the Arctic changing so fast?

A major factor in rapid Arctic warming is a phenomenon called **sea ice albedo feedback**, which makes warming more severe where ice melt occurs. A surface's "albedo" is how reflective it is of sunlight.

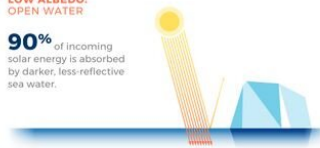
HIGH ALBEDO:
ARCTIC SEA ICE

20% of incoming solar energy is absorbed by highly reflective ice and snow.



LOW ALBEDO:
OPEN WATER

90% of incoming solar energy is absorbed by darker, less-reflective sea water.

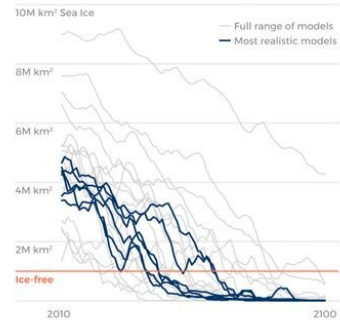


THE FEEDBACK LOOP

When sea ice melts, it uncovers open sea water, which absorbs more sunlight than ice would have. Greater local warming occurs, which in turn leads to further ice loss. This cycle continues.

How soon might seas be "ice-free"?

Global climate models disagree on when Arctic ice will disappear. If we continue on our current greenhouse gas emissions path, models project that Septembers will become functionally ice-free (using scientists' standard definition of sea ice extent under 1 million square kilometers) between 2026 and 2132. Our study set out to narrow this range.



2044–2067

is the range for functional September sea ice disappearance when we include only those global climate models shown to be most realistic in their portrayal of sea ice albedo feedback and ice loss.

Graphic illustrating why the Arctic is changing so fast and how soon Arctic seas might be ice-free. Credit: UCLA Center for Climate Science

The study's lead author is Chad Thackeray, an assistant researcher at the UCLA Institute of the Environment and Sustainability's Center for Climate Science. He said one reason predictions about sea ice loss diverge so much is that they differ in how they consider a process called sea ice albedo feedback, which occurs when a patch of sea ice completely melts, uncovering a seawater surface that's darker and absorbs more sunlight than ice would have. That change in the surface's reflectivity of sunlight, or albedo, causes greater local warming, which in turn leads to further ice melt.

The cycle exacerbates warming—one reason the Arctic is heating up twice as fast as the rest of the globe.

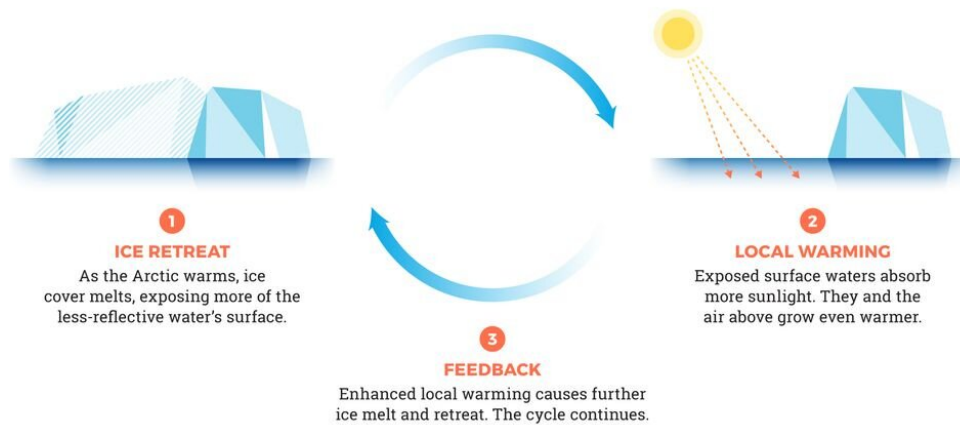
For their study, Thackeray and co-author Alex Hall, a UCLA professor of atmospheric and oceanic sciences, set out to determine which models are most realistic in how they weigh the effects of sea ice albedo feedback, which they figured would lead them to the most realistic projections for sea ice loss.

Luckily—for research purposes, at least—sea ice albedo feedback not only happens over long periods of time due to climate change; it also happens every summer when sea ice melts for the season. And satellite observations over the past few decades have tracked that seasonal melt and resulting albedo feedback.

Thackeray and Hall assessed 23 models' depiction of seasonal ice melt between 1980 and 2015 and compared them with the satellite observations. They retained the six models that best captured the actual historical results and discarded the ones that had proven to be off base, enabling them to narrow the range of predictions for [ice-free](#) Septembers in the Arctic.

Sea Ice Albedo Feedback Cycle

A major factor in the rapid warming of icy places like the Arctic is sea ice albedo feedback, a cycle that makes warming more severe where ice is lost. A surface's "albedo" is how reflective it is of sunlight.



www.ioes.ucla.edu/climate
©2019 UCLA Center for Climate Science



Illustration of how the sea ice albedo feedback cycle works. Credit: UCLA Center for Climate Science

The approach of using an observable process in the current climate to evaluate global climate model projections of future climate was pioneered by Hall and his group in 2006, in a study focused on snow albedo feedback. (As the name implies, snow albedo feedback is similar to sea ice [albedo](#) feedback but involves snow loss uncovering a darker land surface.) It has since become widely used in [climate science](#) as researchers try to improve the precision of their projections.

The fate of Arctic sea ice is a key topic for climate scientists because of its role in temperatures around the rest of the world.

"Arctic sea ice is a key component of the earth system because of its

highly reflective nature, which keeps the global climate relatively cool," Thackeray said.

There are other environmental and economic implications to ice loss as well. Sea ice is critical to the Arctic ecosystem, and to the fishing industry and indigenous peoples who depend on that ecosystem. And as Arctic ice is lost, more waters are used for commercial shipping and oil and gas exploration, which presents economic opportunity for some nations, but which also contributes to further greenhouse gas emissions and [climate change](#).

"The changes to come will have broad environmental, ecological and economic implications," Thackeray said. "By reducing the uncertainty in when we'll see those changes, we can be better prepared."

More information: Chad W. Thackeray et al. An emergent constraint on future Arctic sea-ice albedo feedback, *Nature Climate Change* (2019). [DOI: 10.1038/s41558-019-0619-1](https://doi.org/10.1038/s41558-019-0619-1)

Provided by University of California, Los Angeles

Citation: Arctic Ocean could be ice-free for part of the year as soon as 2044 (2019, November 15) retrieved 27 April 2024 from <https://phys.org/news/2019-11-arctic-ocean-ice-free-year.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.