New studies shine a light on the Arctic's current — and future — affairs

Research reveals long-term ocean stability amid looming sea ice collapse

By Richard Harth, ASU News
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As climate change reshapes the Arctic, two new studies by researchers at Arizona State University and their international collaborators are looking at the future of the area.

One study reveals that the circulation of warm Atlantic waters in the Arctic Ocean has remained remarkably stable over nearly three decades. The other warns that the region known as the “Last Ice Area” — long considered a final refuge for thick, multiyear sea ice — could disappear as early as the 2060s.

Together, these findings offer a sharper understanding of the Arctic’s complex ocean and ice systems. They highlight areas of resilience as well as zones of rapid vulnerability, with profound implications for life on Earth.

"These findings remind us that resilience in one part of the system does not offset fragility in another,” says Peter Schlosser, co-author of the arctic circulation study. “Understanding these dynamics is essential if we are to make timely and meaningful decisions to protect critical parts of the Earth system in the face of accelerating planetary change."

Tracking Atlantic waters through Arctic time

Schlosser, director of ASU’s Julie Ann Wrigley Global Futures Laboratory and a professor with the College of Global Futures, oversaw the highly specialized laboratory analyses that underpin the research during his time in Heidelberg, Germany, and New York. The study was co-authored by Angelica Pasqualini, postdoctoral research scholar in the Global Futures Laboratory, and appears in the Journal of Geophysical Research.

For the study, scientists analyzed tracer data collected from 21 Arctic oceanographic research expeditions conducted between 1987 and 2013. Their goal was to better understand how Atlantic water circulates through the Arctic Ocean. By examining the stability of this subsurface circulation over time, the researchers were able to assess how consistently Atlantic water has been transporting heat into the Arctic.

The ASU researchers — in collaboration with Columbia University and Curt Engelhorn Zentrum Archäometrie in Mannheim, Germany — used a kind of chemical clock to track how Atlantic water moves through the Arctic. This "clock" is similar to carbon dating, but it uses tritium and helium instead. By measuring the radioactive decay of these elements, it reveals how long each parcel of water has been below the surface since it was last exposed to the atmosphere. These warm waters enter through the Fram Strait and Barents Sea, flowing beneath the sea ice and carrying significant heat.

The team confirmed that Atlantic water follows a large, looping path — known as a cyclonic current — as it travels counterclockwise along the edge of the Arctic Ocean's continental slope. They also identified multiple secondary branches guided by deep underwater ridges.

Despite growing concerns about climate-driven disruptions, the study found no significant changes in the speed or route of this circulation over nearly 30 years. This stability is particularly notable given that the Arctic has warmed significantly during this same period. It highlights how some deep ocean processes may be buffered against rapid surface change.

The researchers found that the Atlantic water flows through the Arctic at speeds that vary by location but generally range from 0.8 to 1.5 centimeters per second. This slow but steady current carries heat beneath the halocline — a stratified layer that normally shields sea ice from warmer waters below.

Understanding how this circulation system behaves is crucial, because any disruption could erode that protective barrier and accelerate melting from below.

Decline of the Arctic's final stronghold

In contrast, the second study — led by researchers at McGill University, Columbia University and ASU — indicates that the Last Ice Area, a stretch of thick, multiyear sea ice north of Greenland and Canada, may not survive much longer under current warming trends.

The study appears in the Nature journal Communications Earth & Environment and was co-authored by Stephanie Pfirman, deputy director and professor[1] at the School of Ocean Futures.

Using a high-resolution version of the Community Earth System Model, the researchers simulated sea ice changes under a worst-case emissions scenario. For the first time, they were able to accurately resolve narrow Arctic waterways such as Nares Strait and the channels of the Canadian Arctic Archipelago, which are critical escape routes for drifting sea ice. Earlier models didn't fully account for these drainage channels.

The study finds that these pathways are already exporting significant volumes of ice from the Last Ice Area. As the region's thick ice continues to thin and fragment, exports through these straits could increase dramatically. This means the Last Ice Area could collapse by as early as the 2060s.

The Last Ice Area has been viewed as a potential climate refuge — a place where polar bears, seals, walruses and other ice-dependent species could survive even if the rest of the Arctic loses its summer sea ice. It's also the site of Canada's Tuvaijuittuq Marine Protected Area, whose name means "the ice never melts" in Inuktitut.

But as sea ice mobility increases and protective ice arches across Nares Strait and the Queen Elizabeth Islands collapse earlier in the season — or fail to form at all — this frozen sanctuary may drain away.

"It is easy to misinterpret these findings as showing that protecting the Last Ice Area is a lost cause, but they actually emphasize the need for action now to stabilize temperatures to ensure that the Arctic and other regions maintain critical habitats," Pfirman says.

Two stories, one Arctic

While the studies paint different pictures, they underscore a common theme: the Arctic is in flux, but not uniformly so. Deeper ocean currents may be more resilient than surface ice, and the pace of change depends on both local topography and global climate forces.

The stability of Atlantic water circulation suggests that some deep ocean processes remain buffered against rapid change. Meanwhile, the vulnerability of the Last Ice Area highlights the urgency of reducing greenhouse gas emissions and improving sea ice forecasting.

"The Arctic, driven by human activities, is changing at an unprecedented pace and is sending us signals that action to respond to the impact of this change is needed on a time scale as fast as we have ever seen before," Schlosser says. "Given this situation, we must move beyond short-term responses and commit to systemic solutions to preserve the services the Arctic provides to vital planetary systems on local to global scales."

This story also appears in the fall 2025 issue of ASU's Global Futures Futurecast.

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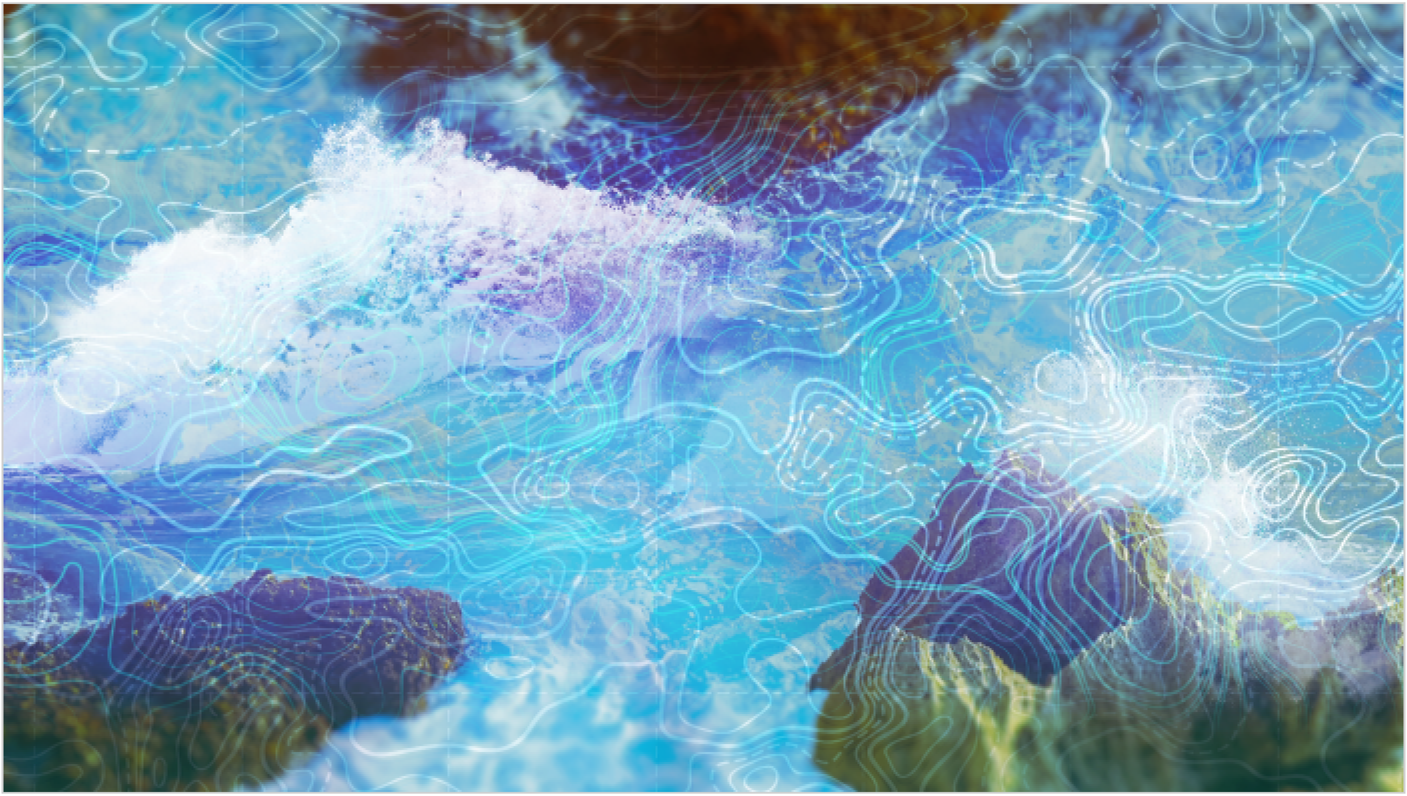
[1] Professor Schlosser holds joint appointments in the School of Sustainability, the School of Ocean Futures, the School of Earth and Space Exploration in The College of Liberal Arts and Sciences, and the School of Sustainable Engineering and the Built Environment in the Ira A. Fulton Schools of Engineering.

Main image



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