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Arctic sea-ice loss: Is the Last Interglacial (127 ka BP) a good analog of our future?

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Variations in sea-ice cover result from a combination of changes in external forcing, internal variability, and feedbacks. Because of the complex interconnections between the mechanisms involved, the long-term evolution of Arctic sea ice and its interaction with the ocean and atmosphere are not yet completely understood, leading to large uncertainties in climate projections.

In this study, we focus on patterns of sea-ice loss in the context of past and future Arctic warming. Using a 7-member global circulation model ensemble from CMIP6/PMIP4, we compare the spatial distribution of the Arctic sea ice in a time-slice simulation representing the climate of the Last Interglacial 127,000 years ago and an idealized CO_2-forced experiment with a similar annual sea-ice volume.

The major differences between the two periods occur close to the sea-ice margins, due to variations in both oceanic and atmospheric circulation regimes. In particular, a positive sea level pressure anomaly forms over Greenland under CO_2 forcing, enhancing the anticyclonic circulation around the island. Consequently, surface winds push more ice along the east coast of Greenland towards the Irminger Sea, where models generally simulate a higher sea-ice concentration in the CO_2-forced experiment than in the Last Interglacial simulation. Analogously, on the western side, a weaker export of ice to the south leads to more ice accumulation in northern Baffin Bay. In the Bering and Barents Seas, the increased inflow of warm Pacific and Atlantic waters causes more ice to melt in the CO_2-forced simulation. In this context, we explore the implication that Atlantification may be more pronounced in the future than during the Last Interglacial period. Finally, the oceanic region north of Greenland is most resilient to sea-ice loss under both the Last Interglacial solar forcing and future CO_2 forcing. This would imply that this region, often referred to as the “Last Ice area,” could also have been the last to lose ice during the Last Interglacial period.