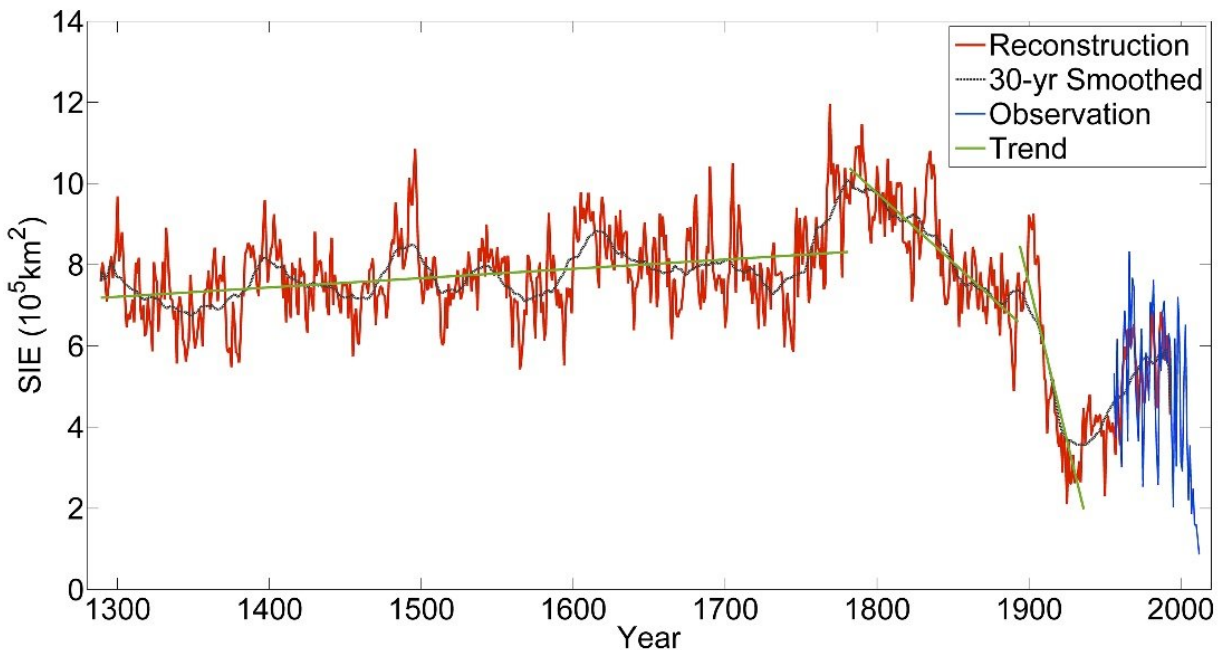


Reconstruction of Arctic Barents-Kara sea ice extent changes over the last millennium

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The Arctic Barents-Kara sea ice extent reconstruction result since 1289 A.D.
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Under the influence of global warming, temperature in the Arctic has increased more significantly than the global average. However, winter extreme cold events in Eurasia including China, have become frequent in recent years. This trend is obviously contrary to global warming. Severe weather with cold surges, ice-snow and frozen rain occurred in southern

China in 2008, and the overwhelming "boss-level" cold wave that attacked almost all of China in 2016 caused heavy casualties and property loss. Scholars believe that these events are closely related to the rapid decline of Arctic sea ice.

The Barents-Kara Sea is considered to be one of the cradles for cold waves over the Eurasian continent, and it is a key sea sector that is closely connected with cold waves over Eurasia. Studies have shown that when the Barents-Kara [sea ice extent](#) is relatively small during autumn and winter, extreme cold wave events are more likely to occur during the winter over Eurasia.

However, controversies still exist. Some scholars believe that the frequent occurrence of extreme cold events over mid-latitudes in the Northern Hemisphere in recent years are ascribed to the internal variability of atmospheric circulation, and they are not significantly related to the decrease in Arctic sea ice.

One of the main reasons for this controversy is that the length of the Arctic sea ice satellite observation data is limited regarding the analysis of changes and causes of Arctic sea ice on a long-term timescale, which severely constrains the understanding of natural variability in Arctic sea ice and its correlation with frequent extreme cold events that occur over mid-latitudes. Therefore, it is necessary to recover the Arctic sea ice time series before the instrumental period and analyze its variations on a longer timescale.

A recent study used reliable mathematical methods combined with high-quality climate proxy data to recover the long time series of the Arctic Barents-Kara Sea ice extent and found that human activities since the industrial revolution have greatly contributed to the decline of Arctic sea ice. An article related to this study was just published in the *Science China Earth Sciences*, with Cunde Xiao, scientist at the Beijing Normal

University, as the corresponding author.

After intercomparing the results and statistical parameters using the ordinary least squares regression, the principle component regression and the partial least squares regression methods, SIE time series were synthesized into a more robust series as the final result by the researchers. The study showed that the Barents-Kara sea ice began to decrease significantly at the end of the 18th century, and a shrinking trend became much more significant during the second half of the 19th century. Even though the sea ice had a short period of expansion during 1940s-1970s. However, it continuously and significantly shrank after 1970s. The reduction sea ice in this area after the end of the 18th century was unprecedented in both duration and speed over the last 700 years. The industrial revolution may be a dominant factor in this result. The Arctic SIE in recent years may be the lowest it has been over the last millennium.

However, sea ice is a complex component in the climate system. Its variation is affected by many factors, such as temperature, atmospheric circulation and ocean current, and its mechanisms of evolution are extremely complex. It is necessary to integrate paleoclimate reconstruction methods with numerical models and machine learning algorithms under the background of the big data era to further improve the results. In addition, we have reconstructed the sea ice extent in the Barents-Kara Sea sector, which is sensitive to triggering extreme cold waves over Eurasia. The changes and interactions in Arctic sea ice between different sea sectors are more important. In the future, we need to collect more high-quality proxy data to reconstruct the sea ice in the entire Arctic region and the different sea sectors.

More information: Qi Zhang et al, Reconstruction of autumn sea ice extent changes since AD1289 in the Barents-Kara Sea, Arctic, *Science China Earth Sciences* (2018). [DOI: 10.1007/s11430-017-9196-4](https://doi.org/10.1007/s11430-017-9196-4)

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