Met Office

The impact of Arctic sea-ice loss on winter weather in the British Isles

This FAQ document was written by Emma Wilson, Ed Blockley and Stephanie Hay

1. How is the Arctic changing?

The Arctic has been warming at an unprecedented rate, at least three times as fast as the global average in the last 50 years (AMAP, 2024). This enhanced warming, known as Arctic amplification, has resulted in a continued shrinking of Arctic sea-ice cover with clear local impacts. New research has now looked at whether this reduction in Arctic sea ice could also have an impact on weather over mid-latitude regions such as the UK and Ireland.

2. What are the key drivers that could influence the UK and Ireland's future winter weather?

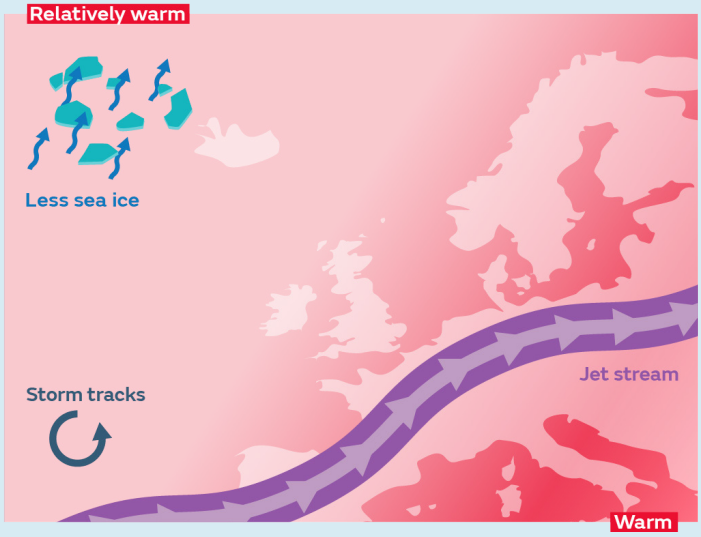
As global temperatures increase, the UK and Ireland may find themselves influenced by two important climatic drivers at the same time, Arctic sea ice loss and ocean warming. Each will play a significant, at times opposing, role in this region's future winter weather.

The jet stream has a crucial influence on the weather and climate in the Northern Hemisphere and is partly driven by the contrast in temperature between the warm tropics and the cold Arctic. As more sea ice is lost due to amplified Arctic warming, this could lead to a gradual weakening of this temperature gradient which, in turn, could impact the location and strength of the jet stream.

However, Arctic sea ice loss isn't happening in isolation. At the same time, ocean warming is occurring, driven by increased global temperatures, with the strongest warming happening in the tropics. In contrast to Arctic sea ice loss, more warming in the tropics could lead to a strengthening of the temperature gradient over the North Atlantic. This could have an equal, but opposite, effect on the jet stream.

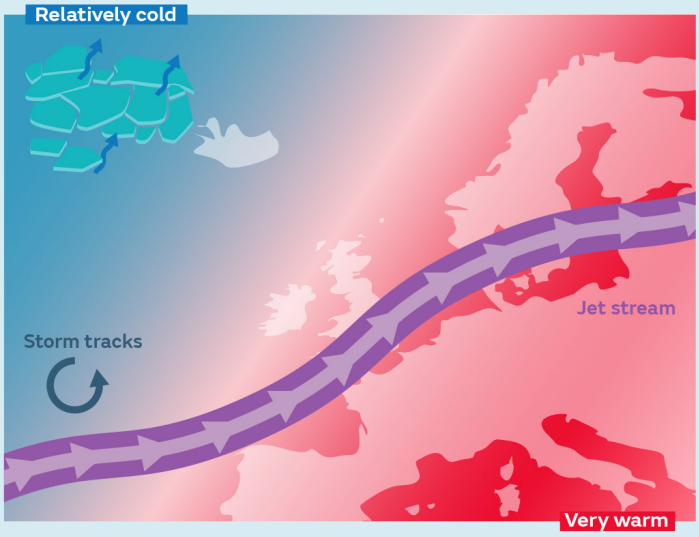
3. What are the effects of Arctic sea ice loss and ocean warming on the jet stream and storminess?

A change in the temperature gradient from the tropics to the Arctic could significantly impact the location, shape and strength of the jet stream, which is a key driver of the frequency, speed and intensity of storms that impact the UK & Ireland.



Sea ice loss

A warming Arctic weakens the temperature gradient with the tropics. This causes the jet stream and storm track to move south.



Tropical ocean warming

Warming tropics strengthen the temperature gradient with the Arctic. This causes the jet stream and storm track to move north.

AMAP, 2024. Arctic Climate Change Update 2024: Key Trends and Impacts. Summary for Policy-makers. Arctic Monitoring and Assessment Programme (AMAP), Tromsø, Norway. 16 pp

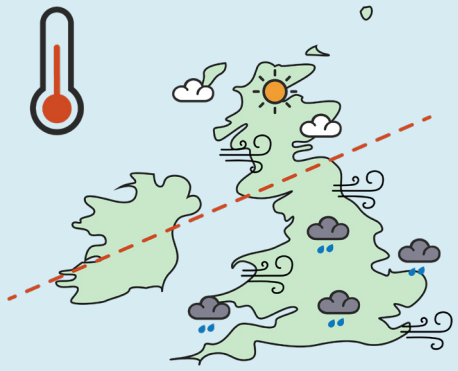
Hay, S., Blockley, E., Catto, J.L., Hewitt, H., Eunice Lo, Y.T., Screen, J.A., et al. (2025) The impact of Arctic sea-ice loss on winter weather in the British Isles. Quarterly Journal of the Royal Meteorological Society, e70012. Available from: https://doi.org/10.1002/qj.70012

A clear 'tug-of-war' exists between sea ice loss and ocean warming for control over the North Atlantic jet stream and storm track. This could potentially complicate future climate projections for the UK and Ireland, with the relative strengths of these effects being crucial to the overall impact.

4. What could future winter weather be like across the British Isles?

Future winter weather over the British Isles will most likely be driven by the location of the jet stream and storm track.

Arctic sea ice loss impact on future winter weather

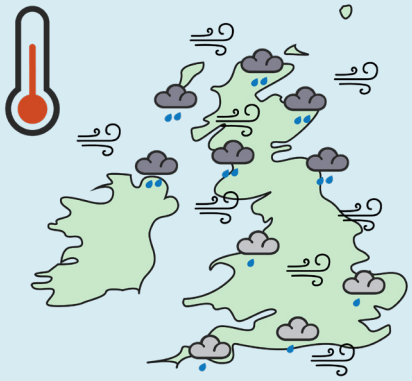


Winds: Calmer winds everywhere

Precipitation: Wetter in the south/east, drier in the north/west

Storms: Fewer, slower, weaker storms everywhere, especially in the north

Global ocean warming impact on future winter weather



Winds: Stronger winds everywhere, particularly in the north

Precipitation: Wetter everywhere

Storms: Higher number of stronger, faster moving storms, especially in the north

Temperature: Warmer conditions are likely across the region in both the above scenarios. Ocean warming will be the dominant driver in increasing temperatures, with the effect of sea ice loss on temperature being very small.

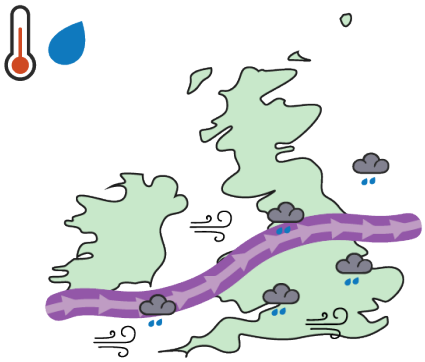
5. What are the possible storylines of Arctic sea ice impact on future UK and Ireland winters?

Future winter weather conditions for the UK and Ireland fall within three possible storylines, depending on the relative magnitude of sea ice loss and ocean warming resulting from global temperature rise.

All storylines lead to wetter, warmer conditions across the region, but still have some differences:

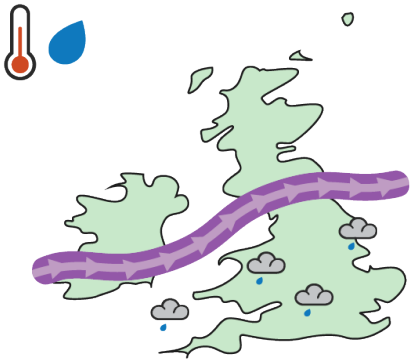
Storyline 1
High sea ice loss

Jet stream and storm track shift southward, leading to weaker, slower storms in the south and less in the north.



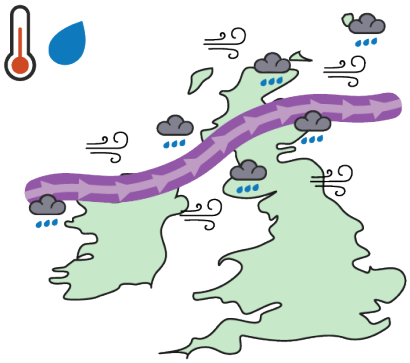
Storyline 2
Medium sea ice loss

Little change in the jet stream or storm track, but the combined effects of sea ice loss and ocean warming lead to southern parts of the UK becoming wetter.



Storyline 3
Low sea ice loss

Jet stream and storm track shift northwards, leading to stronger, faster moving storms in the north, and less in the south.



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