While the Arctic is melting the Gulf Stream remains

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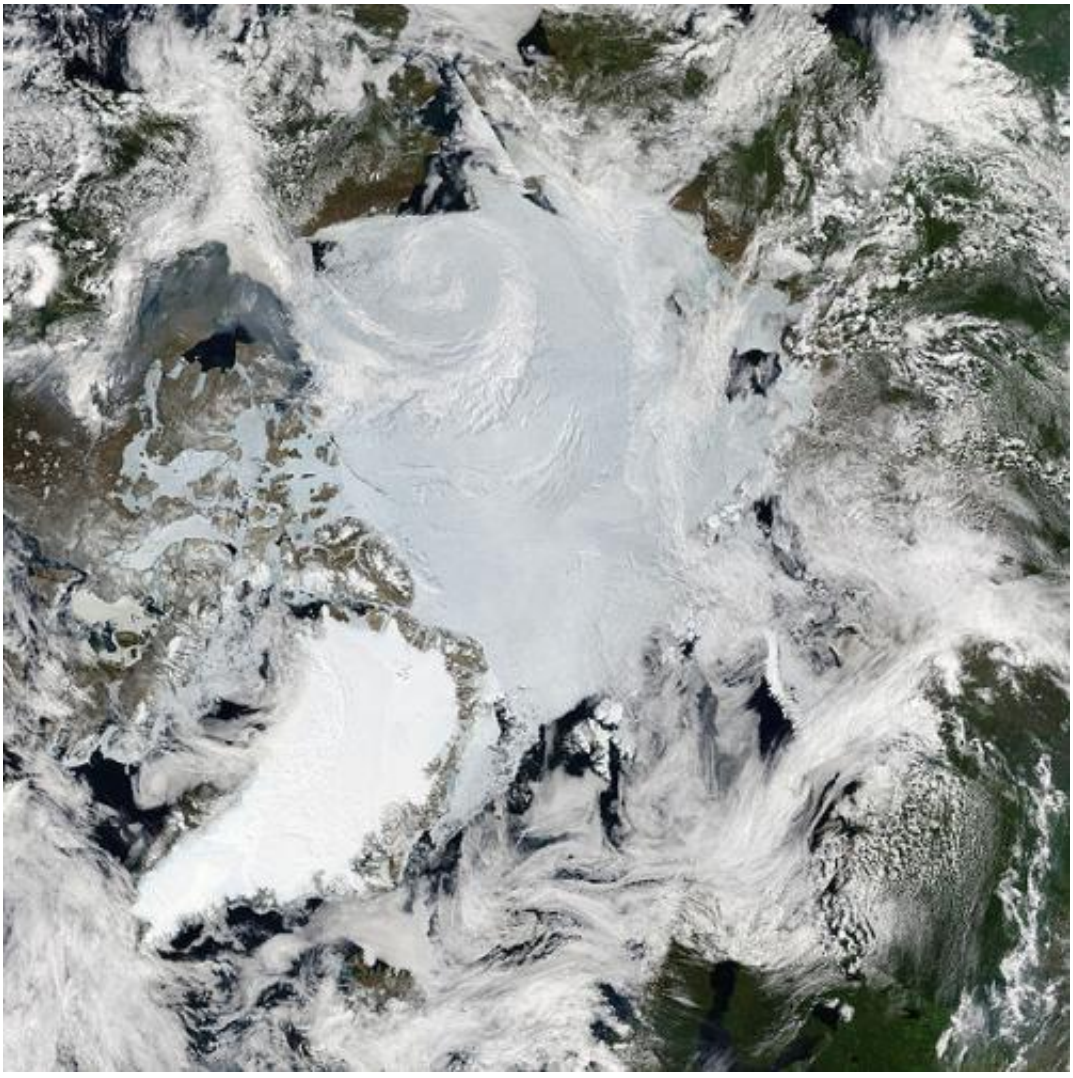

Mosaic of images of the Arctic by MODIS. Credit: NASA

The melting Arctic is not the source for less saline Nordic Seas. It is the Gulf Stream that has provided less salt.

A new study published Sunday in *Nature Geoscience* documents that the source of fresher Nordic Seas since 1950 is rooted in the saline Atlantic as opposed to Arctic freshwater that is the common inference.

"This is an important finding as it shows that the Gulf Stream is not about to short circuit. A halting Gulf Stream has been a concern with ongoing climate change; its collapse was taken to the extreme in the Hollywood blockbuster *The Day After Tomorrow*," says Tor Eldevik, professor in oceanography at the University of Bergen and the Bjerknes Centre.

Reversing the chain of events

The Nordic Seas have freshened substantially since 1950. This has happened at the same time as there has been observed increased river runoff and net ice melting in the Arctic. The concurrence of a less saline ocean and Arctic freshwater input has given the climate research community reason for concern.

"It has been a concern that a layer of Arctic freshwater could impede the Gulf Stream's Arctic branch. Going back in time – into and through ice ages – such a freshwater lid has been understood to reduce ocean circulation and thus the Gulf Stream's poleward heat transport," says Tor Eldevik.

Eldevik is co-author of the study where Mirjam Glessmer and colleagues at the Bjerknes Centre in Bergen, Norway, show that change in the Nordic Seas is at the receiving end of change in the more global climate system. The Nordic Seas are in this case not a precursor in a real world parallel to "The Day After Tomorrow".

Southern freshwater

The researchers from the Bjerknes Centre have analysed the available observations back to 1950 and conclude that the changing salt content in the Nordic Seas is explained by the variable salinity of the Gulf Stream's Arctic branch entering the seas from the south. The mode of operation is also realised in a numerical ocean model forced by the observed stated of the atmosphere during the period in question.

Although not part of the present study, it appears to be several reasons for the freshening of the Atlantic source waters. A dominant explanation is a general increase in net precipitation over the North Atlantic Ocean (which may very well relate to global climate change). The contribution is spread over the Gulf Stream system, and accordingly transported further northward.

The analysis of Glessmer and colleagues further shows, and in line with the above, that the salt deficit in the Nordic Seas is not related to a surface layer of freshwater. The low-salinity anomaly since 1950 is distributed throughout the water column following the Gulf Stream's northern overturning from warm surface flow to cold deep water.

Potential for climate prediction

The study has important practical implications. The Bjerknes Centre is presently developing the Norwegian Climate Prediction Model, with the aim of establishing a Norwegian operational system for climate prediction on seasonal to decadal time scale.

"Our study documents how large-scale changes in our marine climate propagate with the extension of the Gulf Stream into the Nordic Seas. This suggests that the marine climate could be predictable on the time

scale that a climate signal is travelling north," concludes Tor Eldevik.

More information: Glessmer, M.S., T. Eldevik, K. Våge, J.E.Ø. Nilsen, and E. Behrens, 2014: "Atlantic origin of observed and modelled freshwater anomalies in the Nordic Seas." Advance online publication *Nature Geoscience*, dx.doi.org/10.1038/ngeo2259

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