Cold wind makes Norwegian Sea warmer

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(Phys.org)—The Gulf Stream and the warm waters it brings are one reason the climate is milder along the Norwegian coastline than other places so far north. Researchers now know that the Gulf Stream is not only driven from the south, but also drawn northward by Arctic winds.

Norwegian researchers have discovered a previously unknown climate relationship in the seas off Norway: cold wind from the north makes warm waters from the south flow northward along the Norwegian coastline. They explain the phenomenon in this way:

- Northerlies from the Arctic force large volumes of water southward through the Denmark Strait between Iceland and Greenland.
- As this water flows southward, the water level of the Norwegian Sea drops.
- The water that has left the Norwegian Sea must be replaced by new water masses, so enormous amounts of warm water from the south flow into the Norwegian Sea.

The Gulf Stream enters the Norwegian Sea between Iceland, the Faroe Islands and Scotland. Every second, 8-9 million cubic metres of northbound Atlantic Ocean water flows through this area. By comparison, a total of 1.2 million cubic metres of water per second runs into the sea from all the world's rivers combined.

Refutes previous research

Iselin Medhaug is a post-doctoral fellow at the Bjerknes Centre for Climate Research in Bergen. With the help of funding from the Research Council of Norway's large-scale programme on Climate Change and its Impacts in Norway (NORKLIMA), Medhaug completed her doctoral degree at the University of Bergen, where she is studying climate dynamics.

The seemingly paradoxical finding that she and her colleagues have made contradicts conventional thinking: it has long been thought that the Gulf Stream, which brings waters from tropical regions in the Atlantic

Ocean up to the Norwegian Sea, is primarily driven by winds from the south in combination with sinking water masses in the north.

"But when we began to calculate the situation using advanced climate models with data from a number of observations," explains Dr Medhaug, "we discovered that it is actually cold winds from the Arctic that drive much of the process of getting tropical waters in the Gulf Stream to flow northward towards the Norwegian coastline."

Replacing lost waters

To understand how humans affect the climate, more knowledge needs to be generated about natural climate change. Recent research has shown that the climate in Norway and its outlying marine areas is greatly influenced by major, natural fluctuations occurring in both the Atlantic Ocean and the atmosphere above it.

Dr Medhaug's calculations show that the winds from the southwest play a weaker role in driving the Gulf Stream towards Norway than previously thought. Instead, it is the northerlies that "pull" the waters northward by emptying water masses out of the Norwegian Sea.

"The strong current northward off the Norwegian coastline is to a great extent the result of a compensation for water that has flowed away, southward between Greenland and Iceland," continues Dr Medhaug.

Wind reduces Arctic ice

The declining sea ice in the Arctic has been a key topic of discussion concerning the extent to which global warming is caused by human activity.

Now the researchers can confirm that winds from the Arctic are also a key cause of reductions in summer ice in Arctic regions. The winds, together with the southward-flowing Greenland Current (beneath the ice), move the ice southward along both sides of Greenland.

It is thus quite possible that the reductions in ice cover may largely be attributed to natural changes in wind conditions. It cannot be ruled out, however, that anthropogenic changes in climate are one of the factors that have altered these wind conditions.

Retreating ice edge

The researchers at the Bjerknes Centre for Climate Research have also found that when winds from the Arctic draw more warm water to Norway from the south, it leads to more melting of the Arctic ice cover, which is why the ice edge is retreating northward.

This warming process is self-reinforcing through what is known as a feedback loop: with less ice on the marine surface in summer, more heat from the air is absorbed by the seawater, warming the Arctic even more.

Wind conditions in the Arctic are likely to vary naturally in the future as well. During certain periods, more ice will form around the North Pole. Nevertheless, in the long term an increase in anthropogenic emissions of greenhouse gases to the atmosphere could bring about permanent changes that determine the fate of Arctic ice.

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