Warm North Atlantic Ocean promotes extreme winters in US and Europe

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The extreme cold weather observed across Europe and the east coast of the US in recent winters could be partly down to natural, long-term variations in sea surface temperatures, according to a new study published today.

Researchers from the University of California Irvine have shown that a phenomenon known as the Atlantic Multidecadal Oscillation (AMO)—a natural pattern of variation in North Atlantic sea surface temperatures that switches between a positive and negative phase every 60-70 years—can affect an atmospheric circulation pattern, known as the North Atlantic Oscillation (NAO), that influences the temperature and precipitation over the Northern Hemisphere in winter.

When the AMO is in its positive phase and the sea surface temperatures are warmer, the study has shown that the main effect in winter is to promote the negative phase of the NAO which leads to "blocking" episodes over the North Atlantic sector, allowing cold weather systems to exist over the eastern US and Europe.

The results have been published today, Wednesday 2 April, in IOP Publishing's journal *Environmental Research Letters*.

To arrive at their results, the researchers combined observations from the past century with climate simulations of the atmospheric response to the AMO.

According to their observations, sea surface temperatures in the Atlantic can be up to 1.5 °C warmer in the Gulf Stream region during the positive phase of the AMO compared to the negative, colder phase. The climate simulations suggest that these specific anomalies in sea surface temperatures can play a predominant role in promoting the change in the NAO.

Lead authors of the study Yannick Peings and Gudrun Magnusdottir said: "Our results indicate that the main effect of the positive AMO in winter is to promote the occurrence of the negative phase of the NAO. A negative NAO in winter usually goes hand-in-hand with cold weather in the eastern US and north-western Europe."

The observations also suggest that it takes around 10-15 years before the positive phase of AMO has any significant effect on the NAO. The reason for this lag is unknown; however, an explanation might be that AMO phases take time to develop fully.

As the AMO has been in a positive phase since the early 1990s, it may have contributed to the extreme winters that both the US and Europe have experienced in recent years.

The researchers warn, however, that the future evolution of the AMO remains uncertain, with many factors potentially affecting how it interacts with atmospheric circulation patterns, such as Arctic sea ice loss, changes in solar radiation, volcanic eruptions and concentrations of greenhouse gases in the atmosphere.

The AMO also shows strong variability from one year to the next in addition to the changes seen every 60

More information: 'Forcing of wintertime atmospheric circulation by the multidecadal fluctuations of the North Atlantic ocean' Yannick

Peings and Gudrun Magnusdottir 2014 *Environ. Res. Lett.* 9 034018.
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