IOW-Press Release, September 23, 2020

The long arm of the Atlantic:
How the climate of Northern Europe is influenced from afar

Climate researchers at the Leibniz Institute for Baltic Sea Research Warnemünde (IOW) for the first time were able to show with the help of statistical analyses, how fluctuations in the Atlantic Multidecadal Oscillation (AMO) affected the meteorological phenomenon of the North Atlantic Oscillation in the course of the last millennium. They also could establish a link between AMO and climate variables in the Baltic Sea region, such as the spread of sea ice, surface water temperature or river inflow.

The proverbial irrelevance of a sack of rice falling over in faraway Asia has long been disproved: In a globalised world, nothing remains without consequences. But even beyond the global connections created by modern society, everything is interconnected in our "System Earth", even if we do not recognise it at first glance. The second, analytical "glance" is science's business. With the help of a global and regional climate model, a team of authors from the IOW around the climate modeler Florian Börgel has taken a closer look at the long-range effects of the Atlantic on the Baltic Sea during the last millennium regarding temperature, ice cover and river flow. They report surprising results in a recent article published in the international journal Environmental Research Letters.

The weather in Europe is closely linked to the North Atlantic Oscillation (NAO), a fluctuation of air pressure over the North Atlantic. It is characterized by two activity centres well-known from weather reports: the Icelandic low, a low-pressure system over Iceland, and the Azores high, a high-pressure system over the Azores. If both centres are strongly developed and thus the air pressure differences between them very pronounced, one speaks of a positive NAO index. The opposite case – i.e. weak activity centres over Iceland and the Azores – is described by the negative NAO index.

This interplay of air pressure differences over the North Atlantic ensures that in Northern Europe, for example, periods with warm rainy winters alternate with cold dry winter conditions. Based on the global circulation model (ECHO-G), Börgel and his colleagues now analysed for the first time a simulation of the worldwide climate development over the last 850 years with statistical methods to understand the relationship between the NAO and the so-called Atlantic Multidecadal Oscillation (AMO) during this period. The term AMO is used to describe regular fluctuations in the surface water temperature of the Atlantic with a periodicity of 50 to 90 years. This means, simply put, that the Atlantic is quite warm – above average – for about 30 years, followed by 30 rather cold years.

AMO and NAO have been in the focus of climate research for decades. What makes this study so special ist the fact, that the two were examined over almost a millennium and that their interaction was analysed over such a long time period.

The authors found out that the air pressure centres of the NAO shift to the east or west depending on the temperature phase of the Atlantic. By combining these large-scale fluctuations and linkages with a regional circulation model for Europe, the researchers were able to show that the AMO-induced shift of the Azores high and Icelandic low ultimately also caused changes in climate variables in the Baltic Sea region such as sea

ice, water temperature and river flow: During cold (negative) AMO phases, the Icelandic low moved closer to Europe and the NAO gained more influence on the climate in northern Europe, including temperature, precipitation or ice cover in the Baltic Sea. Currently we are at the beginning of such a cold AMO phase.

“For us as Baltic Sea researchers it is important that we understand how the climate in our region works. Our study can help to improve our understanding of the Baltic Sea climate of the future,” Florian Börgel comments on the new findings. And Markus Meier, head of the Physical Oceanography department at the IOW and co-author of the study adds: “A look into the past allows us to see a picture that is still unbiased by climate change. It shows us the backdrop against which global warming is taking place.”

The results can be read in detail at: Börgel, F., Frauen, C., Neumann, T., Meier, H.E.M. (2020): *The Atlantic Multidecadal Oscillation controls the impact of the North Atlantic Oscillation on North European climate*. Environ. Res. Lett. 15 104025
https://doi.org/10.1088/1748-9326/aba925

Scientific contact:
Florian Börgel, IOW Department Physical Oceanography | mobile: +49 (0)171 – 28 64 897
florian.boergel@io-warnemuende.de

Prof. Dr. Markus Meier, Head of the IOW Department Physical Oceanography
Tel.: +49 (0)381 5197 150 | markus.meier@io-warnemuende.de

Media contact:
Dr Kristin Beck: +49 381 5197 135| kristin.beck@io-warnemuende.de
Dr Barbara Hentzsch: +49 381 5197 102 | barbara.hentzsch@io-warnemuende.de

The IOW is a member of the Leibniz Association that connects 96 independent research institutions that range in focus from natural, engineering and environmental sciences to economics, spatial and social sciences and the humanities. The institutes are jointly financed at the state and national levels. The Leibniz Institutes employ a total of 20,000 people, of whom 10,000 are scientists. The total budget of the institutes is 1.9 billion Euros. www.leibniz-association.eu