

Freie Universität Berlin

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Meteorologists at Freie Universität Identify Cause of Cold and Warm Periods during Winter

New Research on Stratospheric Warmings Highlighted in “Nature Geoscience”

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Meteorologists at Freie Universität have found a correlation between warming in the stratosphere and cold or warm winter periods. They observed that there is an increased number of stratospheric warmings, when the heat flow from the North Atlantic into the atmosphere is increased. Trends for winter temperatures can be derived from these new findings. “This could mean that in Europe there will increasingly be periods lasting several decades with predominantly colder winters alternating with periods of warmer winters,” says Semjon Schimanke, who led the research. The meteorologists expect that in the long term their research will help weather forecasters make more accurate predictions.

The phenomenon of stratospheric warming was first discovered in 1952 by Professor Richard Scherhag at the Institute of Meteorology, Freie Universität Berlin. It appeared in the scientific literature as the “Berlin phenomenon.” In the meantime, these events are referred to as “sudden stratospheric warmings,” and 30 have been registered so far.

On average, sudden stratospheric warmings occur in every second winter, and they are very unevenly distributed over the observation period. Only a single stratospheric warming occurred between the winters of 1988/1989 and 1997/1998, while nine have been registered since the beginning of this millennium. So far there has been no explanation. With their new research, the meteorologists at Freie Universität have shown that the intermittent sudden stratospheric warmings are a consequence of the interaction between the North Atlantic, the troposphere, and the stratosphere. They found that an increased number of sudden stratospheric warmings occur when the heat flux from the North Atlantic into the atmosphere is increased.

During the winter months in the lower polar stratosphere, which lies approximately 20 kilometers above the Earth’s surface, temperatures on average are below minus 70 degrees Celsius. The cold temperatures are combined with strong westerly winds that form the southern boundary of the so-called stratospheric polar vortex. This dominant structure is disrupted in some winters or even reversed. Under these conditions the temperatures in the lower stratosphere rise within a few days by more than 50 degrees, and the polar region is warmer than southerly latitudes. This implies a reversal in the west-east winds and the collapse of the polar vortex. Using models and observations, it was possible to show that such sudden stratospheric warmings are initially excited from the troposphere, but then also have a strong influence on tropospheric circulation.

After a sudden stratospheric warming, among other things the differences in pressure between the Icelandic Low and the Azores High are reduced. This pressure difference determines the prevailing wind direction for Central Europe and thus determines whether the European winter turns cold or warm. Thus, for example, the 2009/2010 winter was characterized by a highly disturbed polar vortex, and in many parts of the Northern Hemisphere there was a severe and snowy winter.

FURTHER INFORMATION

- Prof. Dr. Ulrich Cubasch, Institute of Meteorology, Freie Universität
Tel.: +49 (0)30 / 838-71217, Email: Cubasch@zedat.fu-berlin.de
- Semjon Schimanke, Institute of Meteorology, Freie Universität
Email: Semjon.Schimanke@met.fu-berlin.de

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