New calculations suggest more than one in ten chance of colder UK winters

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As the Sun enters a period of low solar activity over the next 50 years, new research has calculated the probability of unusually cold winter temperatures occurring in the UK.

Last year, the same group of researchers, from the University of Reading, linked colder winters in Europe to low solar activity and predicted that the Sun is moving into a particularly low period of activity, meaning the UK will experience more cold winters in the future – potentially similar to those experienced in the Maunder minimum at the end of the 17th century.

The new research, published today in *Environmental Research Letters*, supports recent suggestions that sunspot activity is waning, and goes further, using the behaviour of the Sun over the last 9300 years to predict the probabilities of future solar changes.

Over the next 50 years, the researchers show that the probability of the Sun returning to Maunder minimum conditions is about 10 per cent, raising the chances that the average winter temperature will fall below 2.5 oC to around 1 in 7, assuming all other factors, including man-made effects and El Niño, remain constant.

Put in context, the average UK winter temperature for the last 20 years has been 5.04 oC, however the last three winters have averaged 3.50 °C, 2.53 °C and 3.13 °C, with 2009/10 being the 14th coldest in the last 160 years.

The increased probability of colder winters could hold great value for national infrastructure planning by government organisations who have struggled to adapt to the extreme weather conditions experienced in the UK over the past two years.

It is stressed, however, that these results do not have any implications for

global climate change, which is concerned with average temperatures for all parts of the world and all times of year. The reported changes only apply in winter and are regional – for example, when the winter is colder in Europe it tends to be warmer in Greenland so that there is almost no effect on the global mean.

These studies obtained the average temperatures between December and February for the past 352 years from the Central England Temperature (CET) data series – the world's longest instrumental temperature record, maintained by the UK Met Office, extending back to 1659.

This data set was combined with records of the Sun's activity obtained through the analysis of 'cosmogenic isotopes', which are specific types of carbon and beryllium that are known to be influenced by the Sun.

The magnetic field of the Sun protects the Earth from galactic cosmic rays, which, as they hit the Earth's atmosphere, generate the cosmogenic isotopes which are then deposited in tree trunks and ice sheets. These cosmogenic isotopes can be collected and dated providing a unique insight into the Sun's variability on timescales ranging from years to millennia.

Data from the cosmogenic isotopes suggests that we are currently coming to the end of a grand solar maximum – a period of intense activity in the Sun – and will therefore experience lower solar activity conditions in future,.

Many researchers have argued that temperature changes attributed to the Sun are, in reality, just caused by the internal variability of the climate system; however, the authors have used this 352-year temperature record to show that there is some, albeit small, predictive skill to be gained from solar activity despite it being just one of a number of factors that influence UK weather.

One mechanism that suggests a link between the Sun and recent cold winters is 'blocking'. Low solar activity causes extensive anticyclones that persist for several weeks in the Atlantic Ocean, causing the warm westerly winds to be replaced by cold, continental north-easterly winds. Depending on the position of the anticyclone, this can also lead to clear skies at night causing the land to cool even further.

Lead author Professor Mike Lockwood said, "Our results show that over the next fifty years there is a 10 per cent chance that temperatures will return to Maunder minimum levels. Describing the Maunder minimum as a 'little ice age' is somewhat misleading however.

"Cold winters were indeed more common during the Maunder minimum but there were also some very warm ones between them, summers were not colder, and the drop in average temperatures was not nearly as great, nor as global, as during a real ice age."

More information: "The solar influence on the probability of cold UK winters in the future" by M Lockwood et al. *Environ. Res. Lett.* 6 034004 (2011): iopscience.iop.org/1748-9326/6/3/034004

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