Clear link between solar activity and winter weather revealed

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Scientists have demonstrated a clear link between the 11-year sun cycle and winter weather over the northern hemisphere for the first time.

They found that low solar activity can contribute to cold winters in the UK, northern Europe and parts of America. But high activity from the sun has the opposite effect.

The study helps explain why the UK has been gripped by such cold winters over the last few years: the sun is just emerging from a so-called solar minimum, when solar activity is at its lowest.

'Our research establishes the link between the solar cycle and winter climate as more than just coincidence,' says Dr Adam Scaife from the UK's Met Office, one of the study's authors.

The findings, published in *Nature Geoscience* also raise the tantalising possibility that the regularity of the solar cycle might help weathermen predict cold winter weather over the northern hemisphere.

'We've been able to reproduce a consistent climate pattern, confirm how it works, and quantify it using a computer model. This isn't the sole driver of winter climate over our region, but it is a significant factor and understanding it is important for seasonal to decadal forecasting,' says Scaife.

Up until now, researchers have only managed to see a weak link between

solar activity and winter weather: when the sun is less active, we're more likely to see weak westerly winds during the winter in the northern hemisphere. This pattern suggests that easterly winds could bring cold weather from the continent to the UK.

But scientists have struggled to incorporate these ultraviolet (UV) signals into climate models.

Now, new satellite measurements from NASA's Solar Radiation and Climate Experiment (SORCE) have revealed that differences in UV light reaching the Earth during the 11-year solar cycle are larger than previously thought. The satellite, launched in 2003, is the first ever to measure solar radiation across the entire UV spectrum.

'The instrument on the SORCE satellite divides UV light up into small wavelength regions, providing good spectral resolution. Before this, climate models used broad spectral bands, so couldn't reveal the solar signal,' explains Professor of atmospheric physics, Joanna Haigh from Imperial College London.

Using this new information in a Met Office climate model, Scaife, Haigh, and other researchers from the Met Office and the University of Oxford, demonstrate that it's possible to reproduce the effects of solar variability which show up in climate records.

It seems that in years of low UV activity, unusually cold air forms over the tropics in the stratosphere, about 50 kilometres up. This is balanced by a more easterly flow of air over the mid latitudes – a pattern which then makes its way down to the Earth's surface, bringing easterly winds and cold winters to northern Europe.

But when solar activity is higher than usual – around the peak of the 11-year solar cycle – the opposite happens: strong westerly winds bring

warm air and so milder winters to Europe.

'What we're seeing is UV levels affecting the distribution of air masses around the Atlantic basin. This causes a redistribution of heat – so while Europe and the US may be cooler, Canada and the Mediterranean will be warmer, and there is little direct impact on global temperatures,' explains Sarah Ineson from the Met Office, lead author of the report.

'Even with the most sophisticated atmospheric models, it is very hard to predict weather patterns on seasonal timescales. This study, along with our ongoing research through the NERC Solar Variability and Climate (SOLCLI) consortium, is adding much detail to our current understanding,' says Haigh.

She is keen to point out that this finding is based on just one satellite: 'If there's something wrong with the instrument we used to get this new data, this might not be right.'

Haigh is however, confident of the mechanism. 'While statistical data pointed to links between UV from the sun and winter weather, this new paper explains how those links come about,' she says.

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More information: Sarah Ineson, Adam A. Scaife, Jeff R. Knight, James C. Manners, Nick J. Dunstone, Lesley J. Gray and Joanna D. Haigh, Solar forcing of winter climate variability in the northern hemisphere, *Nature Geoscience*, published 9 October 2011, doi:10.1038/ngeo1282