



Global warming is being caused by humans, not the sun, and is highly sensitive to carbon, new research shows

New research reinforces human-caused global warming and a climate that's highly sensitive to an increased greenhouse effect



New research suggests that clouds amplify global warming, and the sun plays a minor role. Photograph: Frank Rumpenhorst

Over the past few weeks, several important new papers related to human vs. natural [climate change](#) have been published. These papers add clarity to the causes of climate change, and how much global warming we can expect in the future.

First, a [paper published in the Journal of Climate](#) by Jara Imbers, Ana Lopez, Chris Huntingford, and Myles Allen examines the recent IPCC statement that expressed [with 95 percent confidence](#) that humans are the main cause of the current global warming. One of the main challenges in attributing the causes of global warming lies in the representation of the natural internal variability of the Earth's climate.

The study used two very different representations of natural variability. The first model assumed that the present climate has a short and finite memory, and is mostly determined by the recent past. The second model assumed that the climate's internal variability has long memory and the present climate is influenced by all the previous years.

The authors then incorporated each of these representations of natural variability with a statistical approach to estimate the individual contributions of the various factors (e.g. [the sun](#), volcanoes, greenhouse gases) to the increase in average global surface temperature. In each case, the study found that the greenhouse gas-global warming signal was statistically significant, supporting the robustness of the IPCC statement on human-caused global warming. As lead author Jara Imbers told me,

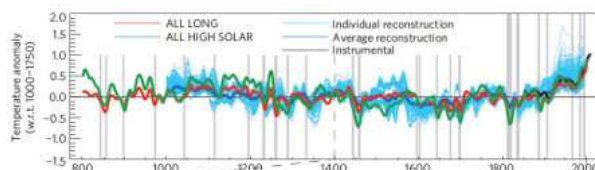
"...we investigate two extreme cases of the plausible temporal structures of the internal variability, and we find that the anthropogenic signal is robust and significant."

Second, a [paper published in Nature Geoscience](#) by Andrew Schurer, Simon Tett, and Gabriele Hegerl investigates the sun's influence on global climate changes over the past 1,000 years. Although we know [the sun can't be causing the current global warming](#)

because solar activity has declined slightly over the past 50 years, "it's the sun" nevertheless remains one of the most popular climate contrarian arguments. However, in recent years, research has pointed in the direction of a relatively small solar impact on the Earth's climate changes.

It's important to realize that while the Earth is bombarded by a lot of heat from the sun, the amount of solar energy reaching the planet is relatively stable. According to the best recent estimates, it's only increased by about 0.1 percent over the past 300 years, causing a global energy imbalance less than 10 percent as large as that caused by humans over the same period.

In this study, the authors tested reconstructions that incorporated relatively large and small changes in solar activity, and compared them to northern hemisphere temperature reconstructions over the past millennium. The reconstruction using a stronger solar influence (green) was a worse fit to the temperature data (blue) than the reconstruction with the weaker solar influence (red), especially around the 12th century.



Simulations with all external climate influences including strong (green) and weak (red) solar influences, compared to the ensemble of northern hemisphere surface temperatures over the past 1,000 years (blue) and instrumental surface temperature measurements (black). From Schurer et al. (2013).

As in the Imbers paper, this study used a statistical approach to determine the contribution of each factor in the measured temperature changes. The authors conclude,

"Volcanic and GHG [greenhouse gas] forcings seem to contribute most to pre-twentieth-century climate variability, whereas the contribution by solar forcing is modest, agreeing with the simulations with low solar forcing."

The study finds that the sun is unlikely to have caused more than 0.15°C of the observed approximately 1°C warming over the past 300 years. The authors find a detectable greenhouse gas influence on the climate before the 20th century, and consistent with the IPCC and Imbers, they conclude that humans are the dominant cause of recent global warming.

"Over the twentieth century, anthropogenic forcings dominate with GHGs the largest forcing, offset by the effect of anthropogenic aerosols and land use changes"

However, the authors note that while the sun has little impact on average hemispheric and global temperatures, it does have a significant influence on regional temperatures, for example in Europe.

Finally, a paper published in Nature by Steven Sherwood, Sandrine Bony, and Jean-Louis Dufresne examines the role that clouds will play in the

