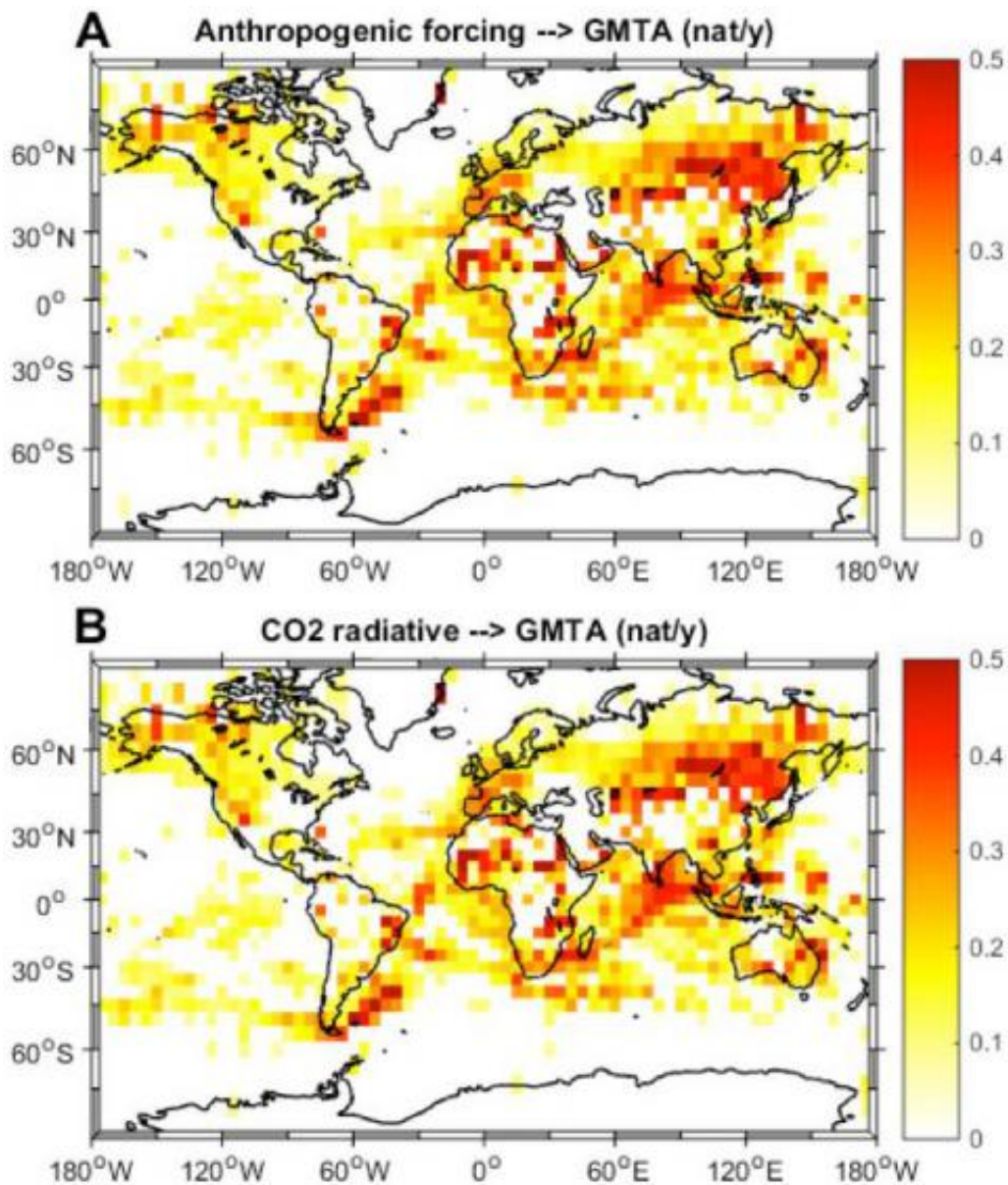


# New evidence confirms human activities drive global warming

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Global causality flow from anthropogenic forcing to global mean surface air

temperature anomalies (GMTA) due to (A) total anthropogenic forcing, (B) the radiative forcing caused by CO<sub>2</sub> alone. Credit: © EU, 2016

A new statistical technique, analysing data records since measuring started 150 years ago, independently confirms that man-made carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>) emissions have led to global warming, according to a JRC-led article published *Nature Scientific Reports*. The analysis also shows that the most pronounced consequences of such emissions are being felt in localised regions around the globe, such as Europe, North America, China, Siberia, the Sahel zone in Africa, and Alaska.

The authors investigated the causes of [global warming](#) using a new statistical method for quantifying causality to analyse the relation between time series data on greenhouse gas emissions and those on [air temperatures](#) in the last 150 years. The results confirm that recent global warming is mainly caused by increased anthropogenic (man-made) emissions and that further CO<sub>2</sub> emissions to the atmosphere will lead to even stronger global warming.

This conclusion cannot be achieved through traditional, time-delayed correlations between temperature and GHG emissions changes or through ordinary least square regression analysis, as neither shows the causal relations. Being based on measured data, the results provide complementary support to model-based studies.

The authors applied the same technique to analyse historical air temperatures and CO<sub>2</sub>/CH<sub>4</sub> data from the past 800,000 years, available thanks to the 3,000 meter deep ice core drilled in Antarctica more than a decade ago, which offers scientists a clue on a time scale of 800 millennia. They found a causal relationship between temperature

increase and rising CO<sub>2</sub>/CH<sub>4</sub> levels, which is the exact opposite of the results for the last 150 years. This also confirms the validity of the technique, as it is well known from the ice core data that in historical times, increase of temperatures had been followed by higher CO<sub>2</sub>/CH<sub>4</sub> emissions. The causality relationship appears to have started reversing around 5000 years ago. The analysis confirms this opposite trend for the last 150 years, when unprecedented amounts of CO<sub>2</sub> started being pumped into the atmosphere in the industrial age.

Looking into the effect of anthropogenic [emissions](#) on different regions, the authors found strong causality between [greenhouse gas emissions](#) and rising temperatures in Europe, North America and China, where densely populated and industrialised areas have shown signs of strong warming. However, a high degree of causality was seen also in Siberia, the Sahel zone in Africa and Alaska, where human presence and associated activities are far less intense. The reasons for this pattern are not yet understood and should therefore become the focus of research to better understand regional climate dynamics.

This observational data-based study, therefore, not only provides complementary support for the results of modelling activities on global climate, but also indicates that further research should be carried out in regions of increased sensitivity to global warming caused by anthropogenic activities. The study was carried out in cooperation with a colleague from China's School of Marine Sciences, Nanjing Institute of Meteorology, who developed the statistical method.

**More information:** Adolf Stips et al. On the causal structure between CO<sub>2</sub> and global temperature, *Scientific Reports* (2016). [DOI: 10.1038/srep21691](https://doi.org/10.1038/srep21691)

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