

# At least part of climate change is man-made

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*Bonn study shows: Since 1880 climate gases have caused just under half of global warming*

In the last 120 years the average global temperature has risen by 0.7 degrees. Over the same period the carbon dioxide concentration in the atmosphere increased from 0.28 to 0.37 per cent. Carbon dioxide is one of the so-called 'greenhouse gases'; methane, which is produced as part of the process of cattle-rearing, for example, is also a greenhouse gas. Its concentration in the atmosphere has risen since 1750 two and a half times. Climatologists regard it as likely that man-made greenhouse gases have contributed to global warming.

However, other factors are also 'in the dock': solar activity, for example, fluctuates in an 11-year rhythm, and volcanic eruptions can also have a profound effect on the climate. Man-made sulphurous particulate matter can even reduce the temperature-raising effect of greenhouse gases.

## **The whole lot of them are guilty, your Honour!**

Bonn meteorologists have now been able to calculate, on the basis of about 30 different climate models, which of the suspects are responsible for climate change: greenhouse gases, particulate matter or natural factors. Their verdict is that they are all guilty. 'Without the influence of the greenhouse gases the average annual temperature would have only increased by 0.4 degrees,' is how Professor Andreas Hense summarises the results. 'However, the fluctuations at the end of the 19th and in the first half of the 20th century are mainly due to changes in solar activity

and volcanic eruptions.' The project was funded by the German Research Association (DFG).

Some scientists are fundamentally sceptical about the reliability of climate models. Prof. Hense and his team, in conjunction with colleagues from the Korean Meteorological Service, therefore subjected one of the simulation models to a thorough scrutiny. The researchers fed the super computer of the Max Planck Institute a total of six times with the available data on the 'suspect' climate factors from the period between 1860 and 2000 – including, for example, solar activity, CO<sub>2</sub> concentration, large volcanic eruptions and the coolant effect of man-made sulphurous particulate matter. Six times they got the computer to simulate the development of the climate over the past 140 years. Six times they had almost identical results: 'The temperature graph calculated was always very similar to the pattern which had been observed in reality,' Prof. Hense emphasises.

The computer was put through its paces six times in order to exclude the possibility of the 'butterfly effect': no one knows exactly what the weather was like on Earth on 1st January 1860. Even the slightest differences in the initial situation can, in time, have big repercussions on the climate. 'This is why we first played around with various plausible initial scenarios, which then formed the basis for subsequent calculations,' Prof. Hense explains.

## **Even after Kyoto it will be warmer**

So the models seem to work for the past. The meteorologists also calculated various future scenarios for the period up to 2100. These show that even on optimistic assumptions the global temperature will continue to rise up to 2050: in a 'green' scenario with greatly reduced greenhouse gas emissions the graph after 2050 stabilises at about one degree above the 1860 level. If greenhouse gas production is only

reduced a little, as could be the case if the Kyoto Protocol is adhered to, the average temperature in 2100 could be even more than two degrees higher. What happens, though, if the human population and the world economy continue to grow and we make no effort to pump less greenhouse gases into the atmosphere? 'In this worst case scenario our model calculates a rise of almost 3.5 degrees,' Prof. Hense says. In fact, US researchers made very similar predictions in a recently published Science study.

Prof. Hense never tires of emphasising that the results are only annual averages for the whole of the Earth, adding: 'We cannot as yet say what effects on individual areas, e.g. Europe, are to be expected.'

Source: University of Bonn

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