LETTERS

Does the Sun affect the Earth's climate?

From Eric Priest, Mike Lockwood, Sami Solanki and Arnold Wolfendale

Svensmark's article in the February issue (*A&G* 2007 **48** 1.18) presented a possible mechanism for the way the Sun could influence the Earth's climate. He suggested that water droplets condense in the ionization trail left by cosmic rays, whose flux varies inversely with solar activity: when the magnetic field of the solar wind is stronger, it shields the Earth from galactic cosmic rays and so decreases their flux on the Earth; according to Svensmark's ideas, this produces fewer clouds and thereby heats the Earth. This raises two key questions: firstly, is this mechanism viable and, secondly, can George Bush gain comfort from it in terms of the origins of present-day climate change?

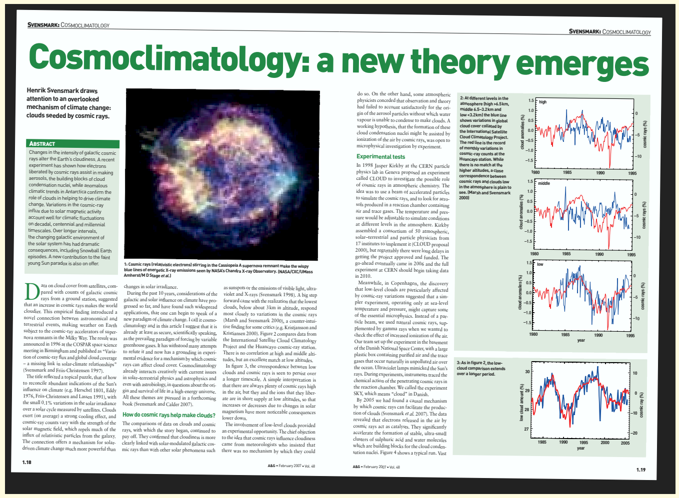
It is now well established that, at least before 1970, there was indeed a correlation between the Earth's climate and solar activity. This can be seen in the papers by e.g. Solanki and Krivova (2003), for the last 150 years and Bond *et al.* (2001) over longer timescales. For instance, in the 17th century (dubbed the "little ice age") the temperature of northern Europe was lower than normal and the river Thames froze over, and this was also a time of very low solar activity (called the "Maunder minimum") when there appear to have been very few sunspots at all for 70 years. Also, the concentration of CO_2 has been measured for the past 650 000 years from ice cores: it decreases during each ice age and goes up in between, to a maximum value that is generally 280 parts per million.

Although these correlations do exist, there is as yet no generally agreed mechanism to explain them. The white-light solar emission does vary, but by only 0.1% over a solar cycle, and the century-scale drift appears to be also of this magnitude, which is too small to explain the variation in the Earth's temperature. One suggestion (not yet proved) is that the UV or EUV emission of the Sun, which varies much more than the white-light emission and which is absorbed high in the atmosphere, could somehow be influencing the low-atmosphere climate and amplifying the solar effect. Another plausible suggestion is the one offered by Svensmark: but it is also not yet proved, since it is at present not clear that the cosmic ray-induced aerosols are in practice strong enough to affect climate. A puzzling feature of the suggestion is that there is no correlation of cosmic-ray flux with high-level clouds – which is where the ionization is highest – and yet an apparent correlation at low levels (below 3.2 km) where the ionization is low. Another difficulty concerns the averaging that is needed, since both cosmic rays and cloud cover vary with latitude in different ways.

So, even if it works, does Svensmark's mechanism give any support to George Bush's attitude that the current global warming is not caused by human activity? Not at all! The observed correlations between the Sun's behaviour and the Earth's climate have completely failed since the 1970s. In the past 30 or 40 years the Earth's temperature has gone up much more rapidly than you would expect from the Sun – indeed there is strong evidence that since 1985 all the changes in the Sun have been in the opposite direction to that required to warm the Earth. Also, the amount of CO_2 in the atmosphere is now 380 parts per million – very much larger than it has been for the past 650 000 years. This was highlighted at a recent meeting in the Royal Society on the science of climate change following on from the IPCC's (Intergovernmental Panel on Climate Change) report reviewing the latest scientific data on global warming.

The mechanism proposed by Svensmark and any influences that the Sun has had on our past climate are valid and interesting fields of study that may well give us valuable new understanding of our climate system. But, in our view, there is no doubt at all that the ongoing global warming is not being caused by the Sun but mainly by the greenhouse gases such as CO_2 that we are emitting. We all, therefore, have a part to play in reducing the greenhouse effect in future – we must not fail to respond to the rapid and unprecedented changes that are taking place today because of debate over the much slower changes that occurred in the past.

Eric Priest, University of St Andrews; and Mike Lockwood, Sami Solanki and Arnold Wolfendale



Cosmoclimatology: a new theory emerges

Henrik Svensmark draws attention to an overlooked mechanism of climate change: clouds seeded by cosmic rays.

References

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Solanki and Krivova 2003 *J. Geophys. Res.* **108** 7.

Find out about climate

From Paul Williams

A&G readers may be interested to note that one of the lead authors of the recent assessment of the state of the climate by the Intergovernmental Panel on Climate Change will be giving a talk about their key findings in London in June. In "Climate Change 2007: the physical science basis", Jonathan Gregory will address questions such as: What recent progress has been made in understanding and attributing climate change? What do observations of the atmosphere, oceans, sea level, snow and ice tell us? What are the projections of future changes?

The lecture will take place at 6.30 p.m. on Wednesday 13 June, at the Institute of Physics, 76 Portland Place, London W1B 1NT. This event is free and open to all, with tea/coffee from 6 p.m. and a light buffet after the talk. Please notify Beverley Harker if you plan to attend, to ensure there is adequate catering (B.J.Harker@open.ac.uk, 01908 655 253). Further information is available from Paul Williams (p.d.williams@reading.ac.uk).

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Sticking up for 'amateur' Huygens

From Jeremy Tatum

I was startled to read (*A&G* 2007) that Titan was discovered by "a Dutch amateur astronomer", a description I have not seen applied before to one of the truly great giants of science of the 17th century.

A Fellow of the Royal Society, Christiaan Huygens is well known to astronomers as the discoverer of Titan and of the true nature of Saturn's rings, and the inventor of the Huygens eyepiece. He is known to students of physics for the Huygens construction in physical optics, which contributed greatly to the understanding of the wave nature of light. With Galileo and Newton he was one of the founders of the science of mechanics. While Galileo is usually credited with the discovery of the approximate isochrony of the simple pendulum, it was Huygens who derived the formula for its period. Huygens showed that a cycloidal pendulum was truly isochronous, independent of its amplitude. Like Harrison much later, Huygens realized that the solution to the determination of longitude at sea lay in the construction of an accurate clock, of which he constructed several, and he wrote authoritatively (*Horologium Oscillatorium*) on the subject. It was during his studies of the conical pendulum that he understood and gave the correct formula for the centripetal acceleration. He correctly analysed, in his famous book *De Motu Corporum*, the conservation of momentum and kinetic energy in elastic collisions, and he introduced the notion of product moment of inertia into the theory of solid-body rotation.

Huygens is honoured today in the name of the Titan lander, but this honour recognizes that one of the great scientists of all time was rather more than "a Dutch amateur astronomer".

Jeremy Tatum, University of Victoria.

Reference

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