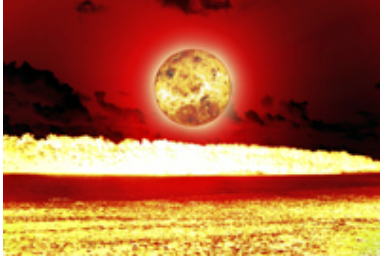


# Solar evidence points to human causes of climate change



**It's getting harder and harder to blame the sun for causing the gradual increase in global temperatures that are now being seen in the climate record, scientists said today.**

In a symposium on the potential role of solar variability — increases in heat coming from the sun — held in Boston at the annual meeting of the American Association for the Advancement of Science, experts in solar science, climate modeling, and atmospheric science explored the issues surrounding who or what is to blame for the rapid rate of change.

There are several possibilities, but the most likely answer is that human industry — that is, heating, cooling, automobile exhaust, manufacturing, and power-generation — is the fundamental culprit. Such activities rely heavily on burning gas, oil, and coal on a massive scale, and the end result includes carbon dioxide, a so-called greenhouse gas that traps the heat radiating from the ground, keeping it from escaping back into space.

"I'm looking for the millennial scale of solar variability," said astronomer Sallie Baliunas, a researcher at the Harvard-Smithsonian Center for Astrophysics in Cambridge. She added that "the records do show variability," such as changes in radioactive carbon-14 abundance and a beryllium isotope in sediment that suggest changes in solar output. "Did the sun cause what we see on the ground?" she asked. "It doesn't seem so. But there is some fuzziness in the data, which suggests it could go either way. The answer isn't known at this time."

What is becoming known, especially from computer models of global climate, is quite gloomy. Warming that was first noticed in the 1960s has increased steadily, and is probably directly linked to human activities.

Scientists suspect the changes in the amount of beryllium-10 and carbon-14 found in various layers of sediment reflect solar activity, because the magnetic disturbances associated with sunspots tend to block the normal flow of cosmic rays reaching the Earth from space. The cosmic rays collide with atoms in the Earth's atmosphere, creating the unusual isotopes; beryllium and carbon thus serve as a "signature" for cosmic-ray and solar activity.

"Our star, the sun, is a variable star," said David H. Hathaway, a sunspot specialist from NASA's Marshall Space Flight Center in Huntsville, Alabama. "It varies by about one-tenth of one percent" in energy output. But "there are suggestions the sun" varies "more than that, because we see it has gone through some periods, such as the Maunder minimum." During the Maunder minimum, which lasted from 1645 to 1715 and is also known as the Little Ice Age, there was an absence or near-absence of sunspots and northern Europe experienced especially cold winters.

Baliunas has also based her research on studying surface activity that is detectable on distant stars that are

reminiscent of the sun. There is considerable variability in the 60 sunlike stars she has examined, she said, depending on how fast each rotates and other factors. Unfortunately, she added, “there is no model to explain [solar surface activity] on the century-to-millennium time scale,” and long-term changes in solar output need further study.

According to Casper M. Ammann, a climate modeler at the National Center for Atmospheric Research in Boulder, Colorado, in the years since 1950, “there is no observed trend” in solar radiation. The 11-year sunspot cycle has not been significantly abnormal. This is just part of the reason for the difficulty of determining the sun’s influence on Earth’s climate. Ammann explained that “for the past 150 years people have tried to see whether the monsoons are linked to the 11-years solar cycle,” but without success.

In essence, he added, it’s now very clear that the atmospheric changes being seen now — global warming — “have nothing to do with changes in solar activity. It’s greenhouse gases. It’s not the sun that is causing this [climate] trend.”

The Earth’s atmosphere — and its relationship to the sun’s energy output — is so complex that even as warming began, “up until 1960 we couldn’t see it.” But now, he said, since warming has been confirmed, the world’s climate scientists “are probably not overestimating the problem. It’s probably worse than the estimates.”

In fact, he said, global warming is occurring at an incredibly rapid rate, faster than any previous episodes of climate change known from the paleo-climate data.

Ammann did add, however, that there is reason to hope that the most dire consequences can be avoided.

Although it’s clearly too late to avoid the heating of the earth’s atmosphere, “we can substantially cut [it]” by severely reducing the amounts of carbon dioxide going into the air. “It is absolutely achievable,” he said — if by mid-century societies can generate enough will to make the necessary changes.

Source: Harvard University

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