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Solar wind warming up Earth?

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Paleoclimate research shows that the chillier periods of the Earth's history have always given way to warmer times, and vice versa.

But it is not quite clear what causes this change. This is what makes predicting climate change so difficult. Although everyone agrees that the climate is changing very fast, hardly anyone can say whether it will be warmer or colder in the next 100 years. At the moment it is getting warmer. The majority attribute this change to human impact on the environment. But are they right?

Lev Zeleny, director of the Institute of Space Research at the Russian Academy of Sciences and an Academy corresponding member, believes that before making Kyoto Protocol-like decisions, we should thoroughly study the influence of all factors and receive more or less unequivocal results. In order to treat an illness, we must diagnose it first, he insists.

Yury Leonov, director of the Institute of Geology at the Russian Academy of Sciences, thinks that the human impact on nature is so small that it can be dismissed as a statistical mistake.

Until quite recently, experts primarily attributed global warming to greenhouse gas emissions, with carbon dioxide singled out as the chief culprit. But it transpires that water vapor is just as bad.

Paleoclimate studies have revealed that during the ice ages the climate became much less damp, because the North Atlantic produced little moisture. The increase in temperature in turn increased humidity, and as a result rivers became fuller and more fresh water flowed into the Arctic and the North Atlantic. This fresh water covered the ocean's surface with a thin film, thereby decreasing evaporation. Another chilly period set in, and the flow of the rivers slowed down, marking the beginning of a new cycle. This is not a linear process – the higher the average temperature, the more steam gets into the air.

"Judging by Venus, a planet, which is similar to the Earth in all respects, we can see how far this can go. The temperature on its surface is about 500° C (mostly due to a greenhouse effect). At one time, Venus did not have a layer of clouds, and this is probably when it was warmed up by the Sun, causing a greenhouse effect. What if the Sun is responsible for the warming of our climate?" queries Lev Zeleny.

"There are two channels of energy transfer from the Sun – electromagnetic and corpuscular radiation," he explains. "The bulk of it – about 1.37 kW per square meter of the Earth's surface – which equals the power of an electric kettle – comes via the electromagnetic channel. This flow of energy primarily fits into the visible and infrared range of the spectrum

and its amount is virtually immune to change – it alters by no more than a few fractions of a percent. It is called the 'solar constant.' The flow of energy reaches the Earth in eight minutes and is largely absorbed by its atmosphere and surface. It has decisive influence on the shaping of our climate."

The second channel is corpuscular radiation, consisting of solar wind and space rays. Although transferring much less energy, it plays a key role in forming "space weather" – changeable conditions in space which depend on solar activity. Until recently, it was believed that "space weather" had nothing to do with ours, but that idea has been proved wrong.

"Solar wind becomes more intense when the Sun is active. It sweeps space rays out of the solar system like a broom," Zeleny points out. "This affects cloud formation, which cools off both the atmosphere and the whole planet. We know from historic records that it was quite cold in 1350-1380. The Sun was very active during this time."

Solar wind is also the main transmitter of energy for geomagnetic phenomena in the Earth's magnetosphere, which is formed as a result of the solar wind streamlining the Earth's magnetic field. If the influx of energy exceeds its dissipation, energy accumulates in the magnetosphere. If a certain level of energy is exceeded, any disturbance outside or inside the magnetosphere may release excess energy and cause a magnetic storm. But it may also have no consequences at all.

A statistical analysis of solar and geomagnetic disturbances shows a rather low correlation between them. It transpires that most solar bursts do not trigger magnetic storms. It would be interesting to know why this correlation is so low.

Nevertheless, other Sun-related phenomena have fairly regular and predictable consequences on the Earth. Of course, they exert influence on humans and other species and, to some extent, on the environment, altering atmospheric pressure and temperature. But they are not likely to contribute much to climate change. This is a global process and is the result of global causes. For the time being, we are far from understanding them fully.

"Some dangers are much less discussed today, for instance, the inversion of the Earth's magnetic field," Zeleny warns. "It is gradually changing its polarity; the poles are crawling to the equator at increasing speed. There were whole epochs in the Earth's history when the magnetic field all but disappeared. Such oscillations have taken place throughout almost its entire geological history."

Paleomagnetic data show that last time the magnetic field disappeared was several hundred thousand years ago. It is possible that the Earth will lose it again in the 21st and 22nd centuries. The "magnetic umbrella," which protects us from deadly space radiation, will disappear, exposing humankind to a heavy "rainfall" of solar particles and space rays. Our descendants will have to understand how a weaker magnetic field will affect the climate and what protection they will need.

Yury Zaitsev is an expert from the Institute of Space Studies.

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