Abstractions

FIRST AUTHOR

Variations in the Sun's total energy output (luminosity) have been implicated in global warming. Peter Foukal, from Heliophysics in Nahant, Massachusetts, and his collaborators reviewed the literature on the possible effects of variations in solar luminosity on global climate (see page 161). These depend mainly on changes in bright and dark magnetic structures — known as faculae and sunspots — on the Sun's surface. The energy output of these variations is too small to have accelerated global warming during the past 30 years, but a different ratio of sunspots to faculae might have contributed to higher solar-irradiance levels in past millennia. *Nature* caught up with Foukal to discuss the political and scientific impact of his work.

Why are you fascinated by the Sun?

The Sun's constantly changing atmospheric structure has fascinated me ever since I first saw it through a telescope as a graduate student. Forty years later, the field still has much unexplored territory.

How does it feel, dealing with so much energy?

Victorian astronomers were the first to measure the Sun's output, and they were impressed by the amount of energy it emits. Now, we take this huge output for granted and are more excited by the power produced by extra-galactic objects such as quasars.

Do you believe that the causes of global warming are solely anthropogenic in nature?

The climate record shows variation across Earth's life time, extending well before any conceivable human impact. But the rapid increases in global temperature and carbon dioxide levels during the past 30 years are difficult to explain by natural variation alone.

Is there a political lesson to be learnt from global warming?

There are many. One scientists are reluctant to admit is that science itself has become big business. The scientific community has developed its own agenda, which can hinder efficient problem-solving.

How do you think this work will affect the debate about the causes and extent of global warming?

Climate simulations continue to be published that use solar brightening during the past few centuries as a much greater factor in global warming than can be justified by current data or theories. We hope that our review clearly presents the arguments against such unreasonable solar driving, and that this will help research into the true causes of global warming. ■

MAKING THE PAPER

David Haussler

Non-coding DNA could hold secrets to what 'makes us human'.

Little is known about the development and evolution of brain features that are specific to humans, and work in this area has so far focused mainly on protein-coding regions of the human genome. But more than 98% of the human genome is made up of non-coding DNA. So, at the start of a search for evolutionarily important non-coding stretches, David Haussler, a bioinformatician at the University of California, Santa Cruz, knew the odds were stacked against him. For any segment to stand out during evolutionary analysis, he says, its evolutionary pattern would have to be so remarkable that it "wouldn't happen by chance with a million tosses of the dice".

To increase the odds, Haussler's group wrote computer programs to search vertebrate genomes for non-coding regions that had changed the least over time. The researchers then looked for evidence of accelerated evolution in these regions in the human genome. After a year, Haussler's then postdoc, Katie Pollard, found 49 statistically significant matches (see page 167). They dubbed these 'human accelerated regions', or HARs. "I didn't actually think we would find any," Haussler says, observing that the likelihood of any region standing out among the tens of thousands tested was very small. "Weird things happen by chance when you do so many tests," he adds. But, by looking at more species and developing more rigorous tests, he and his colleagues honed the technique. One of the 49 HARs — now known as *HAR1* — repeatedly stood out. The group set out to determine its structure and function.

The online genome browser of the Santa Cruz campus was integral to the team's success. It was not only of use for comparing genomic sequences, but provided the first of several lucky breaks. One day, while browsing in the region of the *HAR1* sequence, Pollard noticed that a genome-wide bioinformatic scan by another postdoc in the lab, Jakob Pedersen, had predicted a structural RNA gene at the same location. Biochemical analyses established that *HAR1* does encode a structural RNA.

The team's luck continued. A visiting Belgian colleague, Pierre Vanderhaegen from the Institute of Interdisciplinary Research in Human and Molecular Biology in Brussels, had samples of human embryonic brain tissue from different stages of development, and agreed to test these for *HAR1* expression. The results of his analysis confirmed that *HAR1* was expressed when the cerebral cortex was being laid out. "That was the moment we knew HAR1 was involved in brain development," says Haussler. "These are the sort of results scientists wish for, but seldom get."

Comparing these findings with similar analyses of macaque brain sections, the group found that in the developing cortex the expression pattern of the region has been highly conserved since hominoids diverged from Old World monkeys about 25 million years ago.

Haussler's group is now trying to determine whether HAR1 binds to a protein or interacts with another RNA. Functional studies in mice will follow, as will investigation of other HARs identified by Haussler and his team. ■

KEY COLLABORATIONS

Various crystallographic phases of solid oxygen occur under different conditions. Six are known, but the exact structure of one phase that exists at pressures above 10 GPa has eluded scientists. X-ray diffraction, spectroscopic and theoretical studies have failed to uncover its configuration.

Growing single crystals in this phase is difficult, but Paul Loubeyre and his colleagues at the French Atomic Energy Commission in Bruyères-le-Châtel found a way to do it. They then teamed up with Malcolm McMahon, a physicist at the University of Edinburgh, UK. He and his PhD student, Lars Lundegaard, had perfected a single-crystal diffraction technique on elements such as rubidium and tellurium at the Daresbury Synchrotron Radiation Source in Chesire, UK. Together, they hoped to resolve the long-standing question about oxygen's structure.

McMahon found that four O_2 molecules come together in a rhombohedral shape, probably as a result of weak chemical bonds (see page 201). "The breakthrough was combining our French colleagues' ability to grow a single oxygen crystal with our speciality of single-crystal diffraction techniques," he says.

These first-time collaborators recently received a grant to continue their work on crystals at even higher pressures. ■