

In the March 2008 issue of PHYSICS TODAY, Nicola Scafetta and Bruce West show a graph (page 51) of global surface temperature and total solar irradiance. Two curves of TSI are shown. The red curve shows an increase of TSI since 1980 and is used to argue that global surface temperature is sensitive to TSI. The reference citation for the figure says that data for the red curve are from <http://www.cru.uea.ac.uk> and <http://www.acrim.com>.

Both links show that TSI has not increased since 1980, but instead decreased during that period, so Scafetta and West's red curve disagrees with the cited data sources. That error is serious because it leads to the inaccurate conclusion in the last sentence of the article, that the report from the Intergovernmental Panel on Climate Change should not be trusted.

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Rest assured that the Opinion piece on solar contributions to climate change will find its way hastily into the policy—or should I say political—community and will be misused to stall efforts to limit greenhouse gas emissions. And on what scientific grounds? The work by Nicola Scafetta and Bruce West ignores decades of fundamental physical research and is roundly criticized on technical grounds.^{1,2} More important, their basic approach to the question of how the Sun influences climate defies sound scientific logic.

Despite their sophisticated statistical treatments, the authors commit a fallacy by ignoring an established physical forcing (greenhouse gases) while trying to assess the contribution of a separate forcing (solar irradiance); both push the climate in the same direction, if one assumes that the questionable ACRIM satellite time series on solar irradiance is accurate. With IR-trapping gases omitted, the analysis by Scafetta and West must overestimate the contribution of total solar irradiance variations to surface warming. Is the contribution overestimated slightly or dramatically? The authors' work offers no insights.

Even if Scafetta and West take issue with the statistical treatments done by the Intergovernmental Panel on Climate Change, they should nonetheless appreciate the indispensable requirement to account for all relevant forcings, as the IPCC does in its analyses. If they hope to make an authentic contri-

bution to our understanding of the Sun's role in climate change, they must build on an existing body of knowledge; ignoring more than a century of physical science will not help.

The policy community relies on professional scientific publications to provide sound information on relevant topics. When PHYSICS TODAY publishes opinions that are physically unsound and defy basic scientific logic, the policy community is misled. In my experience, once fundamental misconceptions about science are introduced to the policy community, they are difficult to correct. Moreover, confusion and embarrassment produced by the process of rooting out misconceptions can tarnish a policymaker's image of science.

References

1. J. L. Lean, *Geophys. Res. Lett.* **33**, L15701 (2006).
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Publication of the recent Opinion piece by Nicola Scafetta and Bruce West struck me as potentially blurring the distinction between a peer-reviewed journal article and an opinion piece. Presumably, opinion pieces are held to a dramatically lower standard than journal articles are in terms of peer review, burden of proof, and weight of scientific evidence. Yet publishing something dubbed "opinion" that contains scientific declarations of fact or scientific assertions effectively blurs the crucial distinction between opinions and peer-reviewed research articles. PHYSICS TODAY's audience seems to have a broad focus and therefore to be less likely to evaluate the substance of the scientific claims raised in that or similar pieces.

As has been noted in journalism circles, from the perspective of the public and no doubt elements of the science community as well, "the distinction between reporting and commentary has seriously eroded."¹ The same may well be true for scientific journals; distinctions between opinions and research articles are largely meaningless to those outside science, and that blurring may misinform public perceptions.

The net effect is that the scientific community is more or less obligated to respond to scientific claims made in opinion pieces just as if they had met the standards of scholarly peer review.

The burden of proof then switches from those making claims to the science community at large for disproving each and every such claim.

I urge the editors of professional science journals, including PHYSICS TODAY, to revisit their policies and procedures regarding what constitutes an article versus an opinion. Such distinctions are not without consequence.

Reference

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We enjoyed the article titled "Is Climate Sensitive to Solar Variability?" We commend Nicola Scafetta and Bruce West for their courage in publishing a scientific piece that presents a socially and politically unpopular position.

However, we are concerned about the article's placement in PHYSICS TODAY as an opinion piece. Considering the physical arguments, the reliance on observational and citable data sets, and the attention to mathematical rigor, we wonder what portion of the article is opinion.

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It is good that PHYSICS TODAY reported on the work of Nicola Scafetta and Bruce West. They have done by far the best work in relating solar variability to terrestrial climate, bringing sophistication and rigor to a field dominated mostly by unsupportable positions that the Sun's effect is negligible on the one hand, or is responsible for nearly all observed global warming on the other. That solar variability has appreciable coupling to Earth's climate becomes obvious when an observer notes the imprint of the Schwabe sunspot cycle on the climate temperature record.¹ The identical scaleless noise spectra for solar and terrestrial climate fluctuations provide additional support for coupling and for regarding the Earth-Sun network as a complex system.

Unfortunately, the Intergovernmental Panel on Climate Change clings to its position that solar variability effects are negligible, to the detriment of its credibility. Given known solar variability, the IPCC position can be rationalized only

if the so-called hockey-stick global temperature reconstruction,² which shows little natural variation, is valid. However, that reconstruction is at odds with natural history and has been shown to be statistically flawed;³ more recent reconstructions^{4,5} show much more natural variation. The fact that general circulation models do not give appreciable Sun–Earth coupling merely shows that they are leaving out essential physics—by no means their only serious shortcoming. Unfortunately, the phenomenological approach of Scafetta and West only informs us of the magnitude of the climatic impact of solar variability. It does not shed light on the actual physical mechanisms, so it points to the need for more research on physical coupling mechanisms between those interacting complex systems.

It is also unfortunate that PHYSICS TODAY chose to feature this work as an Opinion, rather than giving it the full-fledged article status it deserves. The readership should be informed in more detail about this important work.

References

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3. E. J. Wegman, D. W. Scott, Y. H. Said, *Ad Hoc Committee Report on the "Hockey Stick" Global Climate Reconstruction*, Committee on Energy and Commerce, US House of Representatives, Washington, DC (2006), available at http://www.climateaudit.org/pdf/others/07142006_Wegman_Report.pdf.
4. A. Moberg et al., *Nature* **433**, 613 (2005).
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Scafetta and West reply: The purpose of an opinion piece is to stimulate debate, a function quite different from that of a research paper. However, for this topic, our piece required more than the usual scientific infrastructure to avoid being dismissed out of hand.

The letter writers, whose opinions are all important, tend to fall into three categories: Peter Foukal attempts a scientific critique of our research; Roger Cohen appears to have closely followed our research and has correctly understood its scientific framework; and the other readers do not seem to know the scientific details of the debate and question our work more from a political or ethical perspective. We limit our response to cover those issues we see as crucial.

Diedrich Schmidt argues that our research is politically tainted because it

was partially supported by the US Army Research Office. That charge is as ridiculous as it is insulting. We speculate, without knowing Schmidt, that he would not level the same accusation at scientists reaching conclusions with which he is sympathetic, regardless of the funding source. In America's scientific community, there is freedom to investigate all sides of controversial issues without fear of political pressure from a funding agency.

Claiming that climate is sensitive to solar variability is not a message of despair, in part because solar activity is forecast to decrease during this century. Regardless of what the Sun may do, however, the scientific issue is what matters, and science must have priority over political correctness in this discussion.

Foukal claims that we are neglecting volcanism's contribution to climate change and cites the important work of Gabriele Hegerl and coworkers (see Foukal's reference 2). We did not neglect that effect. The green curve in our figure (page 51 of the Opinion piece) represents the temperature signal after the volcanic signal has been removed using a technique essentially equivalent to that of Hegerl and coworkers but applied to short time scales. The model simulations (blue and red curves), mistakenly interpreted by Wim Klaassen, have two inputs: the phenomenological signature of the 11-year solar cycle on the temperature, obtained after removing the volcanic signal, and a characteristic response of climate to external forcing of about a decadal time scale, which is essentially what many groups' energy balance models assume.

Hegerl and colleagues attempt to interpret some paleoclimate temperature reconstructions from AD 1000 to AD 2000 by means of a simple multilinear regression analysis constructor, which is essentially a linear fit of more than one variable to the data; in their fit are four components: the Sun, volcanoes, a greenhouse gas plus aerosol component labeled as anthropogenic, and noise (see their equation 2 and table 2). The multilinear fitting coefficients, as expected, strongly depend on the particular paleoclimate temperature reconstruction that is adopted.

A careful reader of that table would notice that for some paleoclimate temperature reconstruction, the fitting parameter referring to the solar forcing is negative. That means that if the paleoclimate temperature data and the model of Hegerl and coauthors are correct, every time the solar irradiance increases, the climate cools, and every

time the solar irradiance decreases, the climate warms. That looks quite unphysical. At the other extreme, if another paleoclimate temperature reconstruction is adopted,¹ the multilinear fits give very different results according to the time period fitted, and the anthropogenic component vanishes when the temperature record is fitted from the years 1001 to 1925.

One crucial difficulty surrounding the climate change issue is the huge uncertainty in the paleoclimate temperature and solar reconstruction data and in the climatic effect of the forcing. For example, according to the 2007 Intergovernmental Panel on Climate Change (IPCC) report, a doubling of carbon dioxide would increase the global temperature between 1.5 K and 4.5 K—not a small range. The uncertainty makes quite problematic the application of the traditional climate model methodology, since it relies on having correct data and sensitivities and on knowing the correct physical mechanisms. Unfortunately, those data, sensitivities, and knowledge are not currently available.

For example, when the traditional climate model simulations are compared with the patterns observed in the temperature data, models significantly underestimate the solar signature: The 11-year solar cycle signature on the surface temperature has a peak-to-trough amplitude of 0.1 K, while the climate models predict an amplitude of 0.035 K (see the Goddard Institute for Space Studies ModelE simulations at <http://www.giss.nasa.gov/tools/modelE>). Thus the models appear to be missing important solar–climate linking mechanisms.

Arguing, as Foukal does, that the total solar irradiance and UV radiation do not have enough power to explain the strength of the link suggests that the physics of the solar–climate linking mechanisms should be further investigated, not that the mechanisms do not exist. To think otherwise would be a logical fallacy of scientific reductionism.

As Cohen correctly observes, one major reason the scientific community has believed that most global warming was anthropogenic is the so-called hockey-stick global temperature reconstruction,² which is based mostly on tree-ring data. It shows little preindustrial climate variability and significant warming since 1900. That pattern supports the theory of manmade global warming.^{2,3} However, the latest studies have shown the limitation of the tree-ring temperature reconstructions and that, on the contrary, climate varied