LETTERS

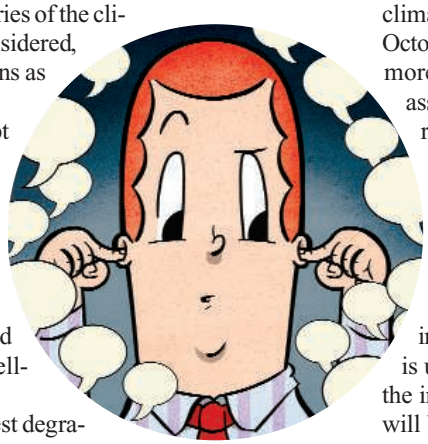
edited by Jennifer Sills

Stop Listening to Scientists?

AS A CLIMATE SCIENTIST AND A CONTRIBUTING AUTHOR TO THE INTERGOVERNMENTAL PANEL on Climate Change, my heart always warms when I hear policy-makers refer to doing what "the science dictates," as President Obama did in his remarks toward the end of the U.N. Climate Change Treaty negotiations in Copenhagen, Denmark. However, after the first-hand experience of the rapid crash of the Copenhagen meeting, I have changed my thinking: World leaders, please stop listening to us! I don't say this because I have lost faith in the verity of scientific results or the projected warming and subsequent global damages. I say this because international policy-makers are adhering too rigidly and too literally to recommended concentration thresholds and emissions targets, and it is crippling the international policy process.

By demanding nothing less than rigid recipes, we have lost valuable momentum. To combat this trend, I offer the following recommendations.

Leave aside the near-obsessive need to benchmark everything against the 2°C target. Science has done a commendable job outlining the boundaries of the climate change problem, and those boundaries are well-considered, rigorous guideposts, but don't use science recommendations as a litmus test for policy success or failure.



Don't let the perfect be the enemy of the good. Accept any binding commitment as long as it demonstrates effort beyond Kyoto or "business as usual" (whichever requires the greater effort). This can be tightened in the future—you can't amend something you don't have.

Lower the rhetoric. Climate politics has evolved to a point where if one side thinks the other side isn't listening, they shout louder and invoke phrases like "genocide" and "murder." Overblown rhetoric inevitably leads to the well-known "donor fatigue."

Other than commitments to slow deforestation and forest degradation, leave forestry complications out of a current agreement. It has generated confusion, raced ahead of science, opened mitigation loopholes, and consumed far too much negotiating oxygen.

To the developing world: Approach funding offers as a starting point to get a funding system flowing. You can't attract new revenue, or extend or add funds, to financing that doesn't exist.

Agree to even loose commitments on monitoring, reporting, and verification (MRV), a key sticking point in the Copenhagen talks. Science can solve this problem, but can't get started without a clear signal and research commitment from all large emitting countries.

Prioritize country commitments to mobilize domestic and international energy research support. In addition to technology transfer opportunities, effort can be directed toward MRV.

In short, we need agreement, even an imperfect agreement, to show a consistent and committed forward momentum. What were general scientific guideposts have become ossified deal-breakers. Instead, we need a sufficient signal to unleash the private and public resources to begin decarbonization. With that, we will start walking in the direction of our goal but leave ourselves open to shortcuts we can't see at the outset.

KEVIN ROBERT GURNEY

Department of Earth and Atmospheric Science, Purdue University, West Lafayette, IN 47907, USA. E-mail: kgurney@purdue.edu

Letters to the Editor

Letters (~300 words) discuss material published in *Science* in the previous 3 months or issues of general interest. They can be submitted through the Web (www.submit2science.org) or by regular mail (1200 New York Ave., NW, Washington, DC 20005, USA). Letters are not acknowledged upon receipt, nor are authors generally consulted before publication. Whether published in full or in part, letters are subject to editing for clarity and space.

Carbon Calculations to Consider

T. SEARCHINGER *ET AL.* ("FIXING A CRITICAL climate accounting error," Policy Forum, 23 October 2009, p. 527) suggest that it would be more scholarly to account for all carbon assimilation and release as function of time rather than just consider biomass as carbon neutral. However, they do not distinguish between felling mature forest to get wood for burning and doing so to grow energy crops. What matters is what is done with the wood from clearing. If combusted, this is a one-time, negative impact on the carbon balance. If the wood is used for house construction or furniture, the immediate climate impact is zero. There will be a negative impact only if these items are later burned.

Some of the same authors recently attacked "second-generation" biofuels (*1*), making the prediction that biofuels will soon be derived entirely from cellulosic material grown on marginal land. This is at variance with another definition of second-generation biofuels: vehicle fuels derived entirely from residues from already-existing biomass cultivation. These are evidently carbon neutral, and no energy inputs are changed. The soil-nutrient balance can be improved because residues from fuel production can be returned to the fields, where they are less likely to foul waterways than are chemical fertilizers. One should remember that most agri- and silvicultural residues are

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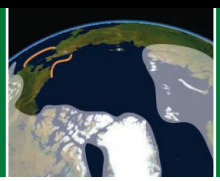

Explaining ice age cycles

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Where chromosomes cross over

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already used today without recycling nutrients, primarily for power and heat plant combustion. The most sustainable option available to us is to use second-generation biofuels along with recycling.

BENT SØRENSEN

Department of Environmental, Social, and Spatial Change. Roskilde University, DK-4000, Denmark. E-mail: boson@ruc.dk

Reference

1. G. P. Robertson *et al*., *Science* **322**, 49 (2008).

Response

OUR POLICY FORUM POINTED OUT A MAJOR flaw when treaties and laws treat all bioenergy as carbon neutral regardless of the source of the biomass. Sørensen's main point appears to be that when mature forests are cleared to plant bioenergy crops, any use of harvested wood to add to the stocks of long-lived wood products preserves some of the carbon and therefore reduces the scope of emissions. We agree. This statement supports our central point that proper accounting of biomass must reflect its effects on carbon stocks and flows.

Unfortunately, using harvested wood for long-lived furniture or housing does not by itself make biomass carbon neutral. When forests are cleared and planted with energy crops or plantation forests, much carbon is lost to the atmosphere from unharvested branches, roots and soils. In addition, many mature forests continue to sequester carbon if left standing (*1*), and the loss of this ongoing carbon sequestration counts as another carbon cost of clearing the forest. Forest regrowth or the displacement of fossil fuels through energy crops provides carbon savings, but analyses that count the amount of harvested wood incorporated into furniture and houses still find that energy crops can take more than 100 years to repay the carbon debt from clearing forests (*2*). Given the urgency of reducing greenhouse gas emissions (*3*), policy should focus on the net effect on emissions over a few decades at most. Over these periods, forest clearing for energy will rarely, if ever, approach carbon neutral outcomes—i.e., cause a 100% reduction in carbon emissions compared to use of fossil fuels. In practice, carbon emissions will often increase (*4*).

Rather than attacking second-generation biofuels, we have distinguished biofuels in both our recent and previous papers based on the feedstock. The key distinction is whether biofuels merely shift carbon from one use to another, which does not reduce greenhouse gases, or instead result in "additional" carbon uptake in plants or reduced biomass decomposition, both of which can reduce greenhouse gases. Whether crop and timber residues are better used for liquid biofuels or electricity and power is a separate question. Many studies have found that using biomass to replace fossil fuels for electricity or power saves more carbon than using biomass for liquid fuels (*5*, *6*). One reason is that much of the energy in biomass is lost in the process of transforming it into a liquid fuel (*7*). Sørensen is correct that such comparisons need to consider the potential benefits of by-products that can displace synthetic fertilizers. Most biofuels do not, and probably will not, produce such by-products. The potentially expanded use of biomass for a wide range of industrial applications highlights the importance of correct accounting.

TIMOTHY D. SEARCHINGER,[1]* STEVEN P. HAMBURG,[2] JERRY MELILLO,[3] WILLIAM CHAMEIDES,[4] PETR HAVLIK,[5] DANIEL M. KAMMEN,[6] GENE E. LIKENS,[7] MICHAEL OBERSTEINER,[5] MICHAEL OPPENHEIMER,[1] G. PHILIP ROBERTSON,[8] WILLIAM H. SCHLESINGER,[7] G. DAVID TILMAN,[9] RUBEN LUBOWSKI[10]

[1]Woodrow Wilson School, Princeton University, Princeton, NJ 08544, USA. [2]Environmental Defense Fund, Boston, MA 02108, USA. [3]The Ecosystems Center, Marine Biological Laboratory, Woods Hole, MA 02543, USA. [4]Nicholas School of Environment, Duke University, Durham, NC 27708, USA. [5]International Institute for Applied Systems Analysis, Laxenburg 2361, Austria. [6]Energy and Resources Group, University of California at Berkeley, Berkeley, CA 94720, USA. [7]Cary Institute of Ecosystem Studies, Millbrook, NY 12545, USA. [8]WK Kellogg Biological Station, Michigan State University, Hickory Corners, MI 49060, USA. [9]Department of Ecology, Evolution and Behavior, University of Minnesota, St. Paul, MN 55108, USA. [10]Environmental Defense Fund, Washington, DC 20009, USA.

*To whom correspondence should be addressed. E-mail: tsearchi@princeton.edu

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2. J. Fargione, J. Hill, D. Tilman, S. Polasky, P. Hawthorne, *Science* **319**, 1235 (2008).
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7. J. D. Ohlrogge *et al*., *Science* **324**, 1019 (2009).

CORRECTIONS AND CLARIFICATIONS

Reports: "Plumage color patterns of an extinct dinosaur" by Q. Li *et al.* (published online 4 February in *Science* Express; 10.1126/science.1186290). In the abstract view, Long Miao was mistakenly included as an author. The author list on the PDF file is correct.

Reports: "Elevated CO_2 reduces losses of plant diversity caused by nitrogen deposition" by P. B. Reich (4 December 2009, p. 1399). The 0.70 and 0.65 values and corresponding <0.0001 values in the first row of Tables 1 and 2, respectively, are the R^2 values and significance values for the whole models (and should not have been placed in the columns labeled "*F* value" and "$P > F$," respectively).

Research Articles: "The pelvis and femur of *Ardipithecus ramidus*: The emergence of upright walking" by C. O. Lovejoy *et al*. (2 October 2009, p. 71; full text online only at http://dx.doi.org/10.1126/science.1175831). The first sentence of the Fig. 4 caption should read, "**Fig. 4.** Lateral (**A**) and posterior (**B**) CT scan surface renders of (Left) MAK-VP-1/1 (*Au. afarensis*, cast) and (Right) ARA-VP-1/701 (*Ar. ramidus*, original)."

Research Articles: "Reexamining human origins in light of *Ardipithecus ramidus*" by C. O. Lovejoy *et al*. (Special Section on *Ardipithecus ramidus*, 2 October 2009, p. 74; full text online only at http://dx.doi.org/10.1126/science.1175834). The article notes that daily sperm production per gram of testes in humans is $<0.06 \times 10^6$. The correct figure is $<6 \times 10^6$.

Reports: "Reversible reactions of ethylene with distannynes under ambient conditions" by Y. Peng *et al*. (25 September 2009, p. 1668). The Figure 2 legend incorrectly stated that average bond angles were measured in degrees Celsius. The bond angles were actually measured in degrees.

Reports: "Allelopathy and exotic plant invasion: From molecules and genes to species interactions" by H. P. Bais *et al*. (5 September 2003, p. 1377). The authors have had difficulty replicating the high and consistent levels of catechin found in soils surrounding *Centaurea maculosa* plants as originally reported (see Fig. 1A). For the most part, catechin seems to be present in low concentrations or not detectable in soils surrounding *C. maculosa* in the field, with the exception of one sampling period during which it was found at concentrations similar to those in the Report [see L. G. Perry, *J. Chem. Ecol.* **33**, 2337 (2007)]. Furthermore, in vitro exudation of catechin by *C. maculosa* roots has not been reproducible by the Vivanco laboratory, and therefore the origin of catechin in the field is unclear. However, the authors have reconfirmed that catechin has the signaling and phytotoxic activities indicated in the Report.

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