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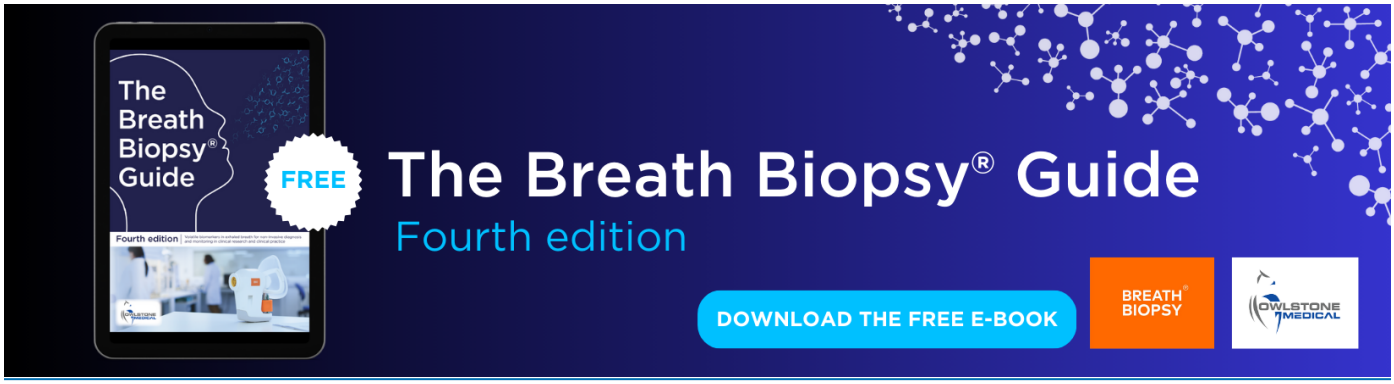

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PERSPECTIVE

History and future of the scientific consensus on anthropogenic global warming

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Abstract
The article by Cook *et al* offers an interesting new methodological approach to the debate about (supposedly lacking) scientific consensus on global warming, showing that contrarian claims that there was no such consensus are clearly misleading. But once the attribution issue can be regarded as settled, new questions and controversies arise. They ultimately result from the different technological and organizational pathways towards a new global society model that takes its adverse climate change effects into account and seeks for new, but also risky solutions.

The article by Cook *et al* (2013) is impressive and convincing: a semantic analysis of almost 12 000 abstracts from scientific, peer-reviewed papers on global warming reveals that only a minority of 0.7% rejects the attribution of global warming to human activities, and a subsequent self-rating of almost 1200 authors of these papers shows that a vast majority of 97.2% endorsed this assumption. Both methods—abstract analysis and self-rating of authors—additionally demonstrate that scientific consensus on anthropogenic global warming (AGW) has been growing in the covered period (1991–2011).

Contrarian claims that there is no consensus among (serious) scientists regarding AGW can clearly be rejected—as has been done before by many other studies (e.g. Oreskes 2004), as the authors of the present article explicitly note.

Why is this finding important? Climate science is a highly politicized science. Not necessarily because climate scientists are advocates of a particular political mission—most climate scientists I know are in fact quite apolitical people. But the issue they are dealing with is clearly political in nature. If global warming was caused by natural factors alone (natural cycles, activity of the sun, volcanoes etc), adaptation to it would still be a necessary human response, but nothing from the broad range of activities that we call 'mitigation' would be necessary or make even sense. But if AGW is a fact, and if avoiding dangerous climate change is a meaningful or even necessary goal, then the de-carbonization of the global economy has to be the answer. This does clearly challenge a range of existing practices, routines, business models, and related policies. It does also devaluate—in a very economic sense—formerly very precious assets, such as coal, oil and gas fields. They turn from private goods to public bads. It is clear that one possible strategy to defend current interests is to 'debunk' climate science. And this has happened, especially in the US (McCright and Dunlap 2003), where the 'consensus gap' between science and the public is particularly marked, most probably reinforced by a mass-media strategy that favors controversies as an indication of 'impartiality', thus misrepresenting the consensus of the experts (Boykoff and Boykoff 2004)—a strategy that French or German mass media do not follow, by the way (Grundmann and Krishnamurthy 2010, Painter and Ashe 2012). Climate science—in other words—is part of a much wider social discourse on climate change (Reusswig and Lass 2010).

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We know from various studies—and the authors of the current article quote some of them—that the perception of scientific consensus adds to the credibility of a message substantially. Non-experts—including most politicians—are more likely to adopt a finding if the additional information is given that a particular finding is backed by the scientific community at large (Lewandowsky *et al* 2012). This is the reason why many contrarians try to maintain the impression that there is no scientific consensus on the causes of global warming. The current article reveals how deceptive this strategy is.

Another strategy is to devaluate consensus as unscientific: many contrarians turn their minority (or non-) position into a strength, comparing themselves to minority scientists at their time that later became science heroes, such as Galilei or Darwin. But while these two were fighting metaphysical or religious belief systems that inhibited empirical evidence, today's contrarians resemble much more the historical adversaries of Galilei or Darwin, often desperately fighting for partial hypotheses while doing away with the balanced empirical evidence of a large community.

Cook and his co-authors may have settled an issue: there is consensus on AGW very early on, and it has been growing with every year of (growing) research activity on the issue. What is next?

My seemingly paradoxical thesis is that this consensus will become less and less relevant in the future. Not necessarily because a settled issue draws human attention away to new challenges. More so because the climate discourse has shifted, and it has shifted exactly because climate scientists have identified the causes of climate change. Once the debate about natural versus anthropogenic causes has been settled, we need to act in order to prevent dangerous climate change to happen, and to adapt to unavoidable change. This poses new questions, also for (climate) science. What technologies, what behaviors, what organizational models, what policies have to be adopted in order to de-carbonize our economies? What are the costs, what are the benefits? How can an effective and fair burden sharing between industrialized and developing countries look like? Can developing countries leap-frog to low-carbon technologies? What does a low-carbon city of the future look like? What are the social actors that can bring low-carbon societies about? And so forth.

If we map these questions to the IPCC, it is clear that the issues dealt with by its Working Group III on mitigation are key to the questions raised. The whole debate about a scientific consensus, about contrarians, skepticism and sound science has been a debate around Working Group I issues, offering the (physical) basis of climate science. In the future, after the debate might have been settled, new questions—and new debates will arise. How sound is climate economics? How can future CO_2 prices be predicted? Is the market the best mechanism to lead us to a low-carbon economy, or will governments and civil society actors have to step in (too)? What can be expected from low-carbon technologies, to what degree do we have to change our lifestyles? And so forth.

Adopting AGW and actively engaging for the de-carbonization of our economies does also create new industries, new markets, new opportunities, new jobs, new political positions, and there will be winners and losers. In addition, there are obvious examples of promising low-carbon strategies (at least at the first sight) that have negative social or environmental side-effects, such as deforesting whole regions for planting palm oil trees or poisoning oceans in order to increase their carbon uptake. Low-carbon societies take the adverse climate effects of their 'predecessor models' actively into account and seek for new technological and organizational pathways to minimize (or neutralize) the global warming potential of their metabolism. In the light of current trends of growing GHG emissions we tend to regard the products and technologies involved as solutions. But we need to see that they also form new business models—and thus new possible conflicts—and go along with new side-effects that need to be assessed in the same critical way we have been assessing 'old' technologies.

Science will be needed—not only in order to find solutions, but also in order to assess the risks associated to them. Given the upfront political nature of the issues mentioned, and the intrinsically multi-paradigmatic character of many social sciences, it is not to be expected that the heroic story of a growing consensus in AGW can be replicated. We—as scientists—will have to explain to policy makers and the wider public that risks and uncertainties will grow, and that waiting for a scientific consensus as a basis for action is

the wrong attitude. Action in the shade of conflict and dissent may be risky in itself, and not very common to political actors that often enough try to hide behind experts. But it seems to be the inevitable future. If this hypothesis is correct, wonderful papers like the one discussed here will become very rare.

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