This is the print version of the Skeptical Science article '97% consensus on human-caused global warming has been disproven', which can be found at http://sks.to/robust97.

The Cook et al. (2013) 97% consensus result is robust

What The Science Says:
The 97% consensus has been independently confirmed by a number of different approaches and lines of evidence.

Climate Myth: 97% consensus on human-caused global warming has been disproven
Cooks '97% consensus' disproven by a new peer reviewed paper showing major math errors (Anthony Watts)

Communicating the expert consensus is very important in terms of increasing public awareness of human-caused climate change and support for climate solutions. Thus it's perhaps not surprising that Cook et al. (2013) and its 97% consensus result have been the subject of extensive denial among the usual climate contrarian suspects. After all, the fossil fuel industry, right-wing think tanks, and climate contrarians have been engaged in a disinformation campaign regarding the expert climate consensus for over two decades. For example, Western Fuels Association conducted a half-million dollar campaign in 1991 designed to 'reposition global warming as theory (not fact).'

The 97% Consensus is a Robust Result

Nevertheless, the existence of the expert consensus on human-caused global warming is a reality, as is clear from an examination of the full body of evidence. For example, Naomi Oreskes found no rejections of the consensus in a survey of 928 abstracts performed in 2004. Doran & Zimmerman (2009) found a 97% consensus among actively publishing climatologists. Anderegg et al. (2010) reviewed publicly signed declarations supporting or rejecting human-caused global warming, and again found over 97% consensus among climate experts. Cook et al. (2013) found the same 97% result through a survey of over 12,000 climate abstracts from peer-reviewed journals, as well as from over 2,000 scientist author self-ratings, among abstracts and papers taking a position on the causes of global warming.

In addition to these studies, we have the National Academies of Science from 33 different countries all endorsing the consensus. Dozens of scientific organizations have endorsed the consensus on human-caused global warming. Only one has ever rejected the consensus - the American Association of Petroleum Geologists - and even they shifted to a neutral position when members threatened to not renew their memberships due to its position of climate denial.

In short, the 97% consensus on human-caused global warming is a robust result, found using several different methods in various studies over the past decade. It really shouldn't be a surprise at this point, and denying it is, well, denial.

Quantifying the Human Global Warming Contribution

There have also been various studies quantifying the human contribution to global warming, as we have previously documented.

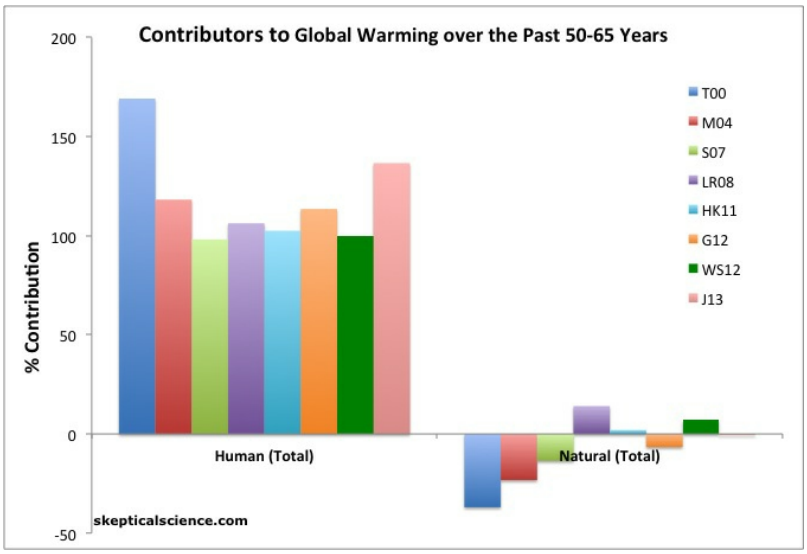

Figure 1: Net human and natural percent contributions to the observed global surface warming over the past 50-65 years according to Tett et al. 2000 (T00, dark blue), Meehl et al. 2004 (M04, red), Stone et al. 2007 (S07, light green), Lean and Rind 2008 (LR08, purple), Huber and Knutti 2011 (HK11, light blue), Gillett et al. 2012 (G12, orange), Wigley and Santer 2012 (WS12, dark green), and Jones et al. 2013 (J12, pink).

Again, there's very little controversy here. The scientific literature is quite clear that humans have caused most of the global surface warming over the past half century, as the 2013 IPCC report stated with 95% confidence.

In Cook et al. (2013), we broadened the focus beyond definitions that quantify the human contribution, because there's a consensus gap on the mere question of whether humans are causing global warming. Nevertheless, we used the 2007 IPCC position as one of our consensus position definitions:

> "We examined a large sample of the scientific literature on global [climate change], published over a 21 year period, in order to determine the level of scientific consensus that human activity is very likely causing most of the current GW (anthropogenic global warming, or AGW)."

The IPCC position (humans causing most global warming) was represented in our categories 1 and 7, which include papers that explicitly endorse or reject/minimize human-caused global warming, and also quantify the human contribution. Among the relatively few abstracts (75 in total) falling in these two categories, 65 (87%) endorsed the consensus view. Among the larger sample size of author self-rated papers in categories 1 and 7 (237 in total), 228 (96%) endorsed the consensus view that humans are causing most of the current global warming.

The self-ratings offer a larger sample size on this quantification question because of the limited real estate in a paper's abstract. Most journals have strict word limits on their abstracts, so authors have to focus on the specifics of their research. On the other hand, the author self-ratings are based on the full papers, which have much more real estate and are thus more likely to both take a position on the cause of global warming, and quantify the human contribution.

Confused Contrarians Think they are Included in the 97%

There have been a number of contrarians claiming that they are part of the 97% consensus, which they believe is limited to the position that humans are causing *some* global warming. The first error in this argument is in ignoring the fact that the data collected in Cook et al. (2013) included categories that quantify the human contribution, as Andrew Montford and the GWPF recently did, for example.

The second error has been made by individuals claiming they're in the 97%, but failing to actually check the data. For example, Roy Spencer claimed in testimony to US Congress that

he is included in the 97% consensus. Since we made all of our data available to the public, you can see our ratings of Spencer's abstracts here. Five of his papers were captured in our literature search; we categorized four as 'no opinion' on the cause of global warming, and one as implicitly minimizing the human influence. Thus Spencer's research was included in the fewer than 3 percent of papers that either rejected or minimized the human contribution to global warming. Bjorn Lomborg made a similar error, claiming:

> "Virtually everyone I know in the debate would automatically be included in the 97% (including me, but also many, much more skeptical)."

In reality Lomborg is included neither in the 97+% nor the less than 3% because as far as we can tell, he has not published any peer-reviewed climate research, and thus none of his writings were captured in our literature search. **The 97% is a consensus of climate science experts**, and that, Lomborg is not.

Nir Shaviv took the opposite approach, claiming he was wrongly included in the 97%. Though Shaviv also admitted that Cook et al. correctly classified his abstracts based on their content, but claimed that he worded the text in a way to slip it past the journal reviewers and editors.

> "I couldn't write these things more explicitly in the paper because of the refereeing, however, you don't have to be a genius to reach these conclusions from the paper."

However, Shaviv, Spencer, and all other authors were invited to participate in the self-ratings process that resulted in the sae 97% consensus conclusion.

Tol's Rejected Comment

Richard Tol has also advanced various criticisms of Cook et al. (2013). It's worth noting that Tol does not dispute the existence of the consensus, writing:

> "There is no doubt in my mind that the literature on climate change overwhelmingly supports the hypothesis that climate change is caused by humans. I have very little reason to doubt that the consensus is indeed correct."

Tol has nevertheless criticized the methods applied during the Cook et al. survey. For example, he has argued that the literature search should have been conducted with Scopus rather than the Web of Science in order to capture more papers, but also that fewer papers should have been included in the survey in order to focus on those specifically researching the causes of global warming. Tol has also applied various statistical tests comparing the abstract ratings to the author self-ratings, but these tests are invalid because the two phases of the survey considered different information (abstracts only vs. full papers) and are thus not comparable.

In fact, when we released the self-rating data, we explicitly discussed the difference between the two datasets and how the difference was actually instructive. As John Cook wrote,

> "That's not to say our ratings of abstracts exactly matched the self-ratings by the papers' authors. On the contrary, the two sets measure different things and not only are differences expected, they're instructive."

Ultimately Tol submitted his criticisms to Environmental Research Letters as a comment, but the submission was summarily rejected by the editor who described it as a speculative opinion piece that does not identify any clear errors that would call the paper's conclusions into question.

In short, the 97% consensus has passed peer-review, while Tol's criticisms have not. Moreover, all of Tol's criticisms only apply to the abstract ratings, while the self-ratings also found the same 97% consensus result, completely independent from the abstract ratings.

Taking Consensus Denial to the Extreme

One critique of the consensus has been published in a paper in the journal Science & Education. The argument made in the paper was first published by Christopher Monckton on a climate contrarian blog. Monckton has also suggested the conspiracy theory that the journal

Environmental Research Letters was created (in 2006) specifically for the purpose of publishing Cook et al. (2013).

The Monckton paper takes the point about quantification above to the extreme. It focuses exclusively on the papers that quantified human-caused global warming, and takes these as a percentage of all 12,000 abstracts captured in the literature search, thus claiming the consensus is not 97%, but rather 0.3%. The logical flaws in this argument should be obvious, and thus should not have passed through the peer-review process.

Approximately two-thirds of abstracts did not take a position on the causes of global warming, for various reasons (e.g. the causes were simply not relevant to or a key component of their specific research paper). Thus in order to estimate the consensus on human-caused global warming, it's necessary to focus on the abstracts that actually stated a position on human-caused global warming.

When addressing the consensus regarding humans being responsible for the majority of recent global warming, the same argument holds true for abstracts that do not quantify the human contribution. We simply can't know their position on the issue - that doesn't mean they endorse or reject the consensus position; they simply don't provide that information, and thus must first be removed before estimating the quantified consensus.

As noted above, when we perform this calculation, the consensus position that humans are the main cause of global warming is endorsed in 87% of abstracts and 96% of full papers. Monckton's argument is very similar to the myth that CO2 can't cause significant global warming because it only comprises 0.04% of the atmosphere. 99% of the atmosphere is comprised of non-greenhouse gases, but these other gases are irrelevant to the question of the CO2 greenhouse effect. The percentage of CO2 as a fraction of all gases in the atmosphere is an irrelevant figure, as is the percentage of abstracts quantifying human-caused global warming as a percentage of all abstracts captured in our literature search.

It's also worth noting that based on Monckton's logic, only 0.08% of abstracts reject human-caused global warming.

Climate Consensus Denialism

Overall, the critiques of Cook et al. (2013) have all exhibited the characteristics of scientific denialism. Given the long history of consensus denial campaigns by fossil fuel interests and climate contrarians, continued resistance to the consensus is an expected result. Nevertheless, the 97% consensus is a robust result from several different studies taking a variety of approaches, including two independent methods used by Cook et al. (abstract ratings and author self-ratings). The criticisms of the paper have all exhibited the same few logical flaws, some more extreme than others, but all erroneous.

Intermediate rebuttal written by dana1981

Update July 2015:

Here is a related lecture-video from Denial101x - Making Sense of Climate Science Denial

[*see video at **this link**.*]

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Skeptical Science explains the science of global warming and examines climate misinformation through the lens of peer-reviewed research. The website won the Australian Museum 2011 Eureka Prize for the Advancement of Climate Change Knowledge. Members of the Skeptical Science team have authored peer-reviewed papers, a college textbook on climate change and the book Climate Change Denial: Heads in the Sand. Skeptical Science content has been used in university courses, textbooks, government reports on climate change, television documentaries and numerous books.

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