Comment on ‘Quantifying the consensus on anthropogenic global warming in the scientific literature’

Richard S.J. Tol

Department of Economics, University of Sussex, BN1 9SL, Falmer, United Kingdom

Institute for Environmental Studies, Vrije Universiteit, Amsterdam, The Netherlands

Department of Spatial Economics, Vrije Universiteit, Amsterdam, The Netherlands

Tinbergen Institute, Amsterdam, The Netherlands

CESifo, Munich, Germany

Abstract

Cook's highly influential consensus study finds different results than previous studies in the consensus literature. It omits tests for systematic differences between raters. Many abstracts are unaccounted for. The paper does not discuss the procedures used to ensure independence between the raters, to ensure that raters did not use additional information, and to ensure that later ratings were not influenced by earlier results. Clarifying these issues would further strengthen the paper, and establish it as our best estimate of the consensus.

The consensus paper by Cook et al. (2013) generated a lot of interest. Consensus is not proof, but occasional stock takes of the state of scientific knowledge are useful for identifying fruitful new research avenues and potential paradigm shifts. Agreement, or perceived agreement, about the extent and causes of climate change has no bearing on rational choices about greenhouse gas emission reduction – those are driven by the trade-offs between the impacts of climate change and the impacts of climate policy – but it does affect the public perception of and the political debate on climate policy, as does the integrity of climate research.

Cook et al. (2013) estimate the fraction of published papers that argue, explicitly or implicitly, that most of the recent global warming is human-made. They find a consensus rate of 96-98%. Other studies[1] find different numbers, ranging from 47% in Bray and von Storch (2007) to 100% in Oreskes (2004) – if papers or experts that do not take a position are excluded, as in Cook et al. If included, Cook et al. find a consensus rate of 33-63%. Other studies range from 40% in Bray and von Storch (2007) to 96% in (Carlton, Perry-Hill, Huber, & Prokopy, 2015). Cook et al. use the whole sample. Other studies find substantial variation between subsamples. Doran and Zimmerman (2009), for instance, find 82% for the whole sample, while the consensus in subsamples ranges from 47% to 97%. Verheggen et al. (2014)

[1] Later studies were found from the forward references to Cook et al. using Scopus. Earlier studies were found from Cook’s backward references, and backward references in backward references.

find 66% for the whole sample, with subsample consensus ranging from 7% to 79%. Figure 1 shows these estimates; see also Table A1 in the Appendix.

Measuring "consensus" is, of course, not easy – the human brain always reinterprets information presented. Different studies may have different objects of consensus. This is illustrated by Carlton et al. (2015) who ask four different questions – about the impact on climate change of human activities, greenhouse gases, carbon dioxide, and the sun – and find four different results for the consensus rate (90%, 96%, 89%, and 71%, respectively). Other survey studies ask slightly different questions again. Oreskes (2004) and Cook et al. (2013) rate abstracts, but where Oreskes finds 75% agreement and 25% no position, Cook has 33% agreement, 66% no position and 1% disagreement. Cook's raters often disagree with each other about the message of a paper (Cook & Cowtan, 2015) and they disagree with the authors too (Tol, 2014a).

These differences notwithstanding, the results by Cook et al. (2013) seem to be at the high end in the consensus literature when "no position" is excluded, and at the low end when included. As Cook et al. have a sample that is so much larger than in other studies, you would expect its results to lie towards the centre of earlier results. Figure 1 highlights that this is not the case.

It may be that there is a trend in consensus findings, and that study by Cook et al. stands out because it is recent. Cook et al. (2013) argue that there is an upward trend in consensus but Tol (2014a) shows that this is a trend in composition rather than agreement. There appears to be no trend in the consensus rate across studies. There is no statistically significant trend in the results that include all. There is a statistically significant trend in the results that exclude "no position", but this trend disappears if the 1996 Bray and von Storch estimate is omitted. See Figure A1 in the appendix.

The problem may lie in the methodology of Cook et al. (2013) – although earlier papers are not above criticism either (Duarte, 2014; Peiser, 2005). Reusswig (2013) praises Cook et al. but Legates, Soon, Briggs, and Monckton of Brenchley (2013) and Tol (2014a) question its data and methodology (Bedford & Cook, 2013; Cook et al., 2014a; Tol, 2014b). Dean (2015) notes that the paper omits inter-rater reliability tests. Cook and Cowtan (2015) add these. These methodological exchanges omit the following five points:

- Cook et al. (2013) do not show tests for systematic differences between raters. Abstract rater IDs may or may not be confidential (Queensland, 2012, 2014), but the authors could have reported test results without revealing identities.
- The paper argues that the raters were independent. Yet, the raters were drawn from the same group. Cook et al. (2013) are unfortunately silent on the procedures that were put in place to prevent communication between raters.
- The paper states that "information such as author names and affiliations, journal and publishing date were hidden" from the abstract raters. Yet, such information can easily be looked up. Unfortunately, Cook et al. (2013) omit the steps taken to prevent raters from gathering additional information, and for disqualifying ratings based on such information.
- Cook et al. (2013) state that 12,465 abstracts were downloaded from the Web of Science, yet their supporting data show that there were 12,876 abstracts. A later query

returned 13,458, only 27 of which were added after Cook ran his query (Tol, 2014a). The paper is silent on these discrepancies.

- The date stamps, which may or may not have been collected (Cook, 2013; Cook et al., 2014b), reveal that the abstracts were originally rated in two disjoint periods (mid-February to mid-April; second half of May). There was a third period of data collection, in which neutral abstracts were reclassified. Unfortunately, Cook et al. (2013) do not make clear what steps were taken to ensure that those who rated abstracts in the second and third periods did not have access to the results of the first and second periods.

It would be of considerable benefit to readers if these issues would be clarified, if at all possible. That would help to convince people that the results of Cook et al. are not just different but better than those in other studies.

Cook et al. (2013) renewed interest in the question how to communicate (climate) science. While several studies show that people respond to cues about the scientific consensus (Guy, Kashima, Walker, & O'Neill, 2014; Myers, Maibach, Peters, & Leiserowitz, 2015; Van der Linden, 2015; van der Linden, Leiserowitz, Feinberg, & Maibach, 2014, 2015), other studies show that this effect is dominated in the long run by other factors (Bliuc et al., 2015; Campbell & Kay, 2014; Kahan, 2015).

Acknowledgements

Oliver Bothe, Collin Maessen, Ken Rice, Bart Verheggen and two anonymous referees had excellent comments on a previous version of the paper.

References

Anderegg, W. R. L., Prall, J. W., Harold, J., & Schneider, S. H. 2010. Expert credibility in climate change. ***Proceedings of the National Academy of Sciences of the United States of America***, 107(27): 12107-12109.

Bedford, D., & Cook, J. 2013. Agnotology, Scientific Consensus, and the Teaching and Learning of Climate Change: A Response to Legates, Soon and Briggs. ***Science and Education***, 22(8): 2019-2030.

Bliuc, A. M., McGarty, C., Thomas, E. F., Lala, G., Berndsen, M., & Misajon, R. 2015. Public division about climate change rooted in conflicting socio-political identities. ***Nature Climate Change***, 5(3): 226-229.

Bray, D., & von Storch, H. 2007. The Perspectives of Climate Scientists on Global Climate Change, Vol. 2007/11: 1-132. Geesthacht: GKSS.

Bray, D., & von Storch, H. 2010. CliSci2008: A Survey of the Perspectives of Climate Scientists Concerning Climate Science and Climate Change, Vol. 2010/9: 1-124. Geesthacht: GKSS.

Campbell, T. H., & Kay, A. C. 2014. Solution aversion: On the relation between ideology and motivated disbelief. ***Journal of Personality and Social Psychology***, 107(5): 809-824.

Carlton, J. S., Perry-Hill, R., Huber, M., & Prokopy, L. S. 2015. The climate change consensus extends beyond climate scientists. ***Environmental Research Letters***, 10(9): 094025.
Cook, J. 2013. Query re request for Cook et al. data: University of Queensland.
Cook, J., & Cowtan, K. 2015. Reply to Comment on 'Quantifying the consensus on anthropogenic global warming in the scientific literature'. ***Environmental Research Letters***, 10(3): 039002.
Cook, J., Nuccitelli, D., Green, S. A., Richardson, M., Winkler, B., Painting, R., Way, R., Jacobs, P., & Skuce, A. 2013. Quantifying the consensus on anthropogenic global warming in the scientific literature. ***Environmental Research Letters***, 8(024024).
Cook, J., Nuccitelli, D., Skuce, A., Jacobs, P., Painting, R., Honeycutt, R., Green, S. A., Lewandowsky, S., Richardson, M., & Way, R. G. 2014a. Reply to 'Quantifying the consensus on anthropogenic global warming in the scientific literature: A re-analysis'. ***Energy Policy***, 73(0): 706-708.
Cook, J., Nuccitelli, D., Skuce, A., Way, R., Jacobs, P., Painting, R., Honeycutt, R., Green, S. A., Lewandowsky, S., & Coulter, A. 2014b. 24 Critical Errors in Tol (2014) - Reaffirming the 97% consensus on anthropogenic global warming. Brisbane: SkepticalScience, University of Queensland.
Dean, B. J. F. 2015. Comment on 'Quantifying the consensus on anthropogenic global warming in the scientific literature'. ***Environmental Research Letters***, 10(3): 039001.
Doran, P. T., & Zimmerman, M. K. 2009. Examining the scientific consensus on climate change. ***Eos***, 90(3): 22-23.
Duarte, J. L. 2014. Comment on "scientists' views about attribution of global warming". ***Environmental Science and Technology***, 48(23): 14057-14058.
Guy, S., Kashima, Y., Walker, I., & O'Neill, S. 2014. Investigating the effects of knowledge and ideology on climate change beliefs. ***European Journal of Social Psychology***, 44(5): 421-429.
Kahan, D. M. 2015. Climate-science communication and the measurement problem. ***Political Psychology***, 36(S1): 1-43.
Legates, D. R., Soon, W., Briggs, W. M., & Monckton of Brenchley, C. 2013. Climate Consensus and 'Misinformation': A Rejoinder to Agnotology, Scientific Consensus, and the Teaching and Learning of Climate Change. ***Science and Education***.
Milloy, S. 2007. Global warming's senseless consensus, ***Canada Free Press***.
Myers, T. A., Maibach, E., Peters, E., & Leiserowitz, A. 2015. Simple messages help set the record straight about scientific agreement on human-caused climate change: The results of two experiments. ***PLoS ONE***, 10(3).
Oreskes, N. 2004. Beyond the Ivory Tower: The scientific consensus on climatic change. ***Science***, 306(5702): 1686.
Peiser, B. 2005. The letter science magazine rejected. ***Energy and Environment***, 16(3-4): 685-687.
Queensland, U. o. 2012. Institutional approval form for experiments on humans including behavioural research. In U. o. Queensland (Ed.), Vol. 2012000639.
Queensland, U. o. 2014. UQ and climate change research.
Reusswig, F. 2013. History and future of the scientific consensus on anthropogenic global warming. ***Environmental Research Letters***, 8(031003).
Stenhouse, N., Maibach, E., Cobb, S., Ban, R., Bleistein, A., Croft, P., Bierly, E., Seitter, K., Rasmussen, G., & Leiserowitz, A. 2013. Meteorologists' Views About Global Warming: A Survey of American Meteorological Society Professional Members. ***Bulletin of the American Meteorological Society***, 95(7): 1029-1040.

Tol, R. S. J. 2014a. Quantifying the consensus on anthropogenic global warming in the literature: A re-analysis. ***Energy Policy***, 73(0): 701-705.

Tol, R. S. J. 2014b. Quantifying the consensus on anthropogenic global warming in the literature: Rejoinder. ***Energy Policy***, 73(0): 709.

Van der Linden, S. 2015. The conspiracy-effect: Exposure to conspiracy theories (about global warming) decreases pro-social behavior and science acceptance. ***Personality and Individual Differences***, 87: 171-173.

van der Linden, S. L., Leiserowitz, A. A., Feinberg, G. D., & Maibach, E. W. 2014. How to communicate the scientific consensus on climate change: plain facts, pie charts or metaphors? ***Climatic Change***, 126(1-2): 255-262.

Van der Linden, S. L., Leiserowitz, A. A., Feinberg, G. D., & Maibach, E. W. 2015. The scientific consensus on climate change as a gateway belief: Experimental evidence. ***PLoS ONE***, 10(2).

Verheggen, B., Strengers, B., Cook, J., Van Dorland, R., Vringer, K., Peters, J., Visser, H., & Meyer, L. 2014. Scientists' views about attribution of global warming. ***Environmental Science and Technology***, 48(16): 8963-8971.

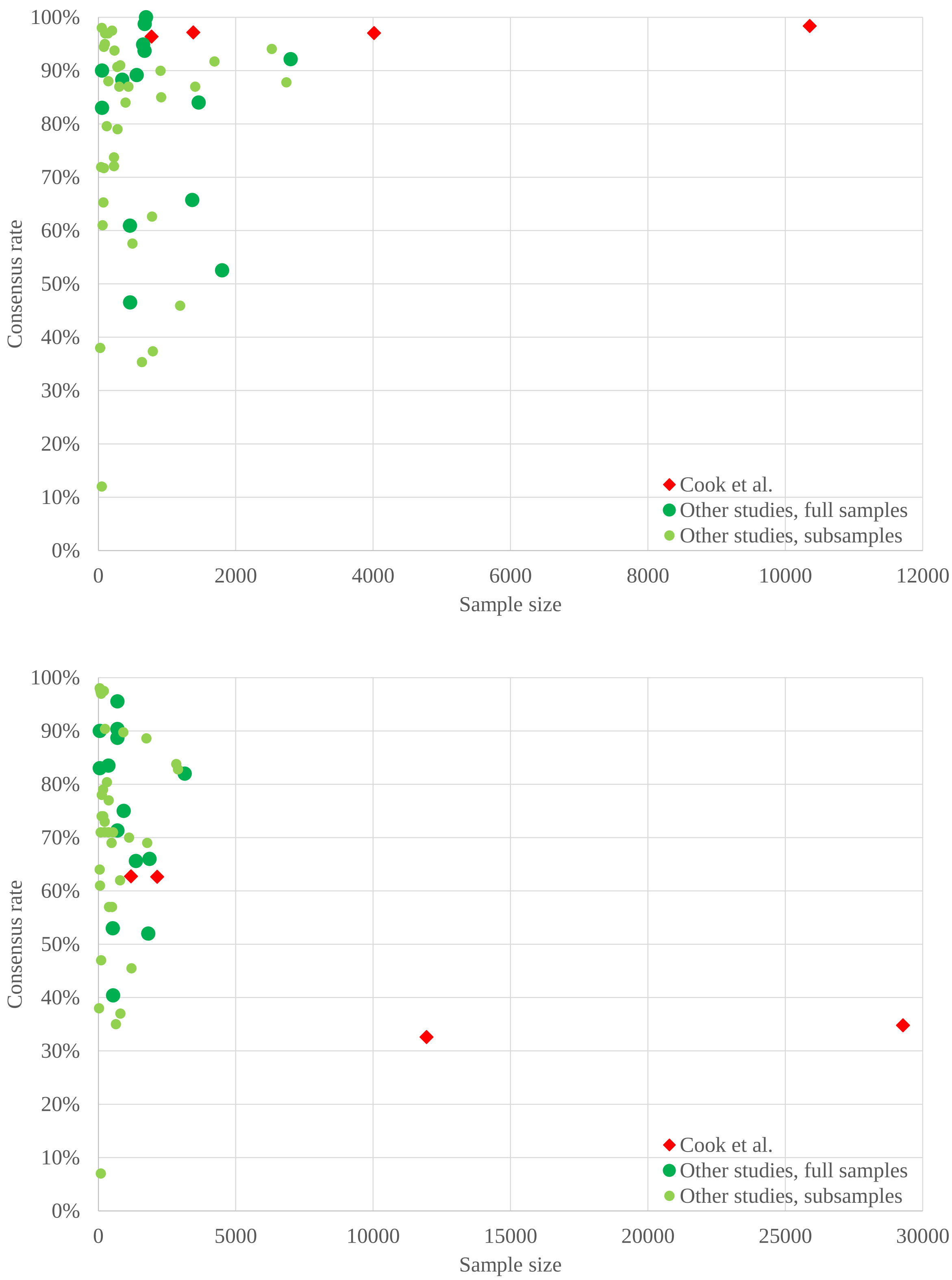

Figure 1. Estimates of the consensus on anthropogenic global warming according to Cook et al. and other studies (Bray, Oreskes, Doran, Anderegg, Stenhouse, Verheggen) as a function of the sample size; the top panel excludes don’t know / no position, the bottom panel includes don’t know / no position.

Table A1. Details of consensus estimates: lead author, year of publication, year of research, sample size, method, estimated consensus rate, object of study.

Study	Year	Excl. don't knows		Incl. don't knows		method	object
		N	rate	N	rate		
(Bray & von Storch, 2007)	1996	539	40.4%	464	46.5%	survey	climate scientists
	2003	530	53.0%	461	60.9%	survey	climate scientists
(Oreskes, 2004)	2004	928	75.0%	696	100.0%	other-rated abstracts	number of papers
(Milloy, 2007)	2007	54	83.0%	54	83.0%	survey	IPCC scientists; more CO_2 implies warming
	2007	54	90.0%	54	90.0%	survey	IPCC scientists; less CO_2 implies cooling
(Bray & von Storch, 2010)	2008	370	83.5%	350	88.3%	survey	climate scientists
(Doran & Zimmerman, 2009)	2008	3146	82.0%	2800	92.1%	survey	earth scientists
	2008	2833	83.8%	2524	94.1%	survey	USA
	2008	313	80.4%	277	90.7%	survey	international
	2008	244	90.4%	235	93.8%	survey	active
	2008	2902	82.8%	2737	87.8%	survey	non-active
	2008	1749	88.6%	1690	91.7%	survey	publishing
	2008	103	47.0%	74	65.3%	survey	economic geologists
	2008	77	97.4%	79	94.5%	survey	climate scientists
	2008	47	64.0%	42	71.9%	survey	meteorologists
(Anderegg, Prall, Harold, & Schneider, 2010)	2009	1372	65.6%	1369	65.7%	public statements	all
	2009	908	89.8%	906	90.0%	public statements	20+ climate papers
	2009	200	97.5%	200	97.5%	public statements	most publications
	2009	100	97.0%	100	97.0%	public statements	most publications
	2009	50	98.0%	50	98.0%	public statements	most publications
(Cook et al., 2013)	2012	11944	32.6%	4014	97.1%	other-rated abstracts	number of papers
	2012	29286	34.8%	10356	98.4%	other-rated abstracts	number of authors
	2012	2142	62.7%	1381	97.2%	self-rated papers	number of papers
	2012	1189	62.7%	774	96.4%	self-rated papers	number of authors
(Stenhouse et al., 2013)	2012	124	78.0%	122	79.6%	survey	climate scientists, climate focus
	2012	82	71.0%	81	71.7%	survey	climate scientists, other focus

	2012	26	38.0%	26	38.0%	survey	climate scientists, not publishing
	2012	232	71.0%	229	72.1%	survey	climate scientists
	2012	61	61.0%	61	61.0%	survey	meteorologists, climate focus
	2012	501	57.0%	496	57.6%	survey	meteorologists, other focus
	2012	641	35.0%	635	35.4%	survey	meteorologists, not publishing
	2012	1203	45.5%	1192	45.9%	survey	meteorologists
	2012	231	73.0%	229	73.7%	survey	climate focus
	2012	790	62.0%	782	62.6%	survey	other focus
	2012	800	37.0%	792	37.4%	survey	not publishing
	2012	1821	52.0%	1803	52.5%	survey	all
(Verheggen et al., 2014)	2012	1868	66.0%	1461	84.0%	survey	all
	2012	388	57.0%	278	79.0%	survey	3- climate papers
	2012	480	69.0%	396	84.0%	survey	4-10 climate papers
	2012	373	71.0%	304	87.0%	survey	11-30 climate papers
	2012	379	77.0%	319	91.0%	survey	32-300 climate papers
	2012	174	79.0%	142	97.0%	survey	IPCC AR4 WG1 authors
	2012	1118	70.0%	914	85.0%	survey	IPCC WG1
	2012	534	71.0%	438	87.0%	survey	IPCC WG2
	2012	120	74.0%	94	95.0%	survey	IPCC WG3
	2012	175	74.0%	146	88.0%	survey	focus on attribution, aerosols, clouds
	2012	88	7.0%	50	12.0%	survey	unconvinced of anthropogenic climate change
	2012	1780	69.0%	1411	87.0%	survey	convinced of anthropogenic climate change
(Carlton et al., 2015)	2014	698	90.4%	673	93.7%	survey	biophysicists; human activity caused warming
	2014	698	95.5%	675	98.7%	survey	biophysicists; more CO_2 implies warming
	2014	698	88.7%	653	94.9%	survey	biophysicists; CO_2 affects climate
	2014	698	71.3%	558	89.2%	Survey	biophysicists; sun has not caused warming

Figure A1. Estimated consensus rates, with and without the “no position” results, as a function of the time of research.