

Examining the Scientific Consensus on Climate Change

Fifty-two percent of Americans think most climate scientists agree that the Earth has been warming in recent years, and 47% think climate scientists agree (i.e., that there is a scientific consensus) that human activities are a major cause of that warming, according to recent polling (see <http://www.pollingreport.com/enviro.htm>). However, attempts to quantify the scientific consensus on anthropogenic warming have met with criticism. For instance, *Oreskes* [2004] reviewed 928 abstracts from peer-reviewed research papers and found that more than 75% either explicitly or implicitly accepted the consensus view that Earth's climate is being affected by human activities. Yet *Oreskes's* approach has been criticized for overstating the level of consensus acceptance within the examined abstracts [*Peiser*, 2005] and for not capturing the full diversity of scientific opinion [*Pielke*, 2005]. A review of previous attempts at quantifying the consensus and criticisms is provided by *Kendall Zimmerman* [2008]. The objective of our study presented here is to assess the scientific

consensus on climate change through an unbiased survey of a large and broad group of Earth scientists.

An invitation to participate in the survey was sent to 10,257 Earth scientists. The database was built from *Keane and Martinez* [2007], which lists all geosciences faculty at reporting academic institutions, along with researchers at state geologic surveys associated with local universities, and researchers at U.S. federal research facilities (e.g., U.S. Geological Survey, NASA, and NOAA (U.S. National Oceanic and Atmospheric Administration) facilities; U.S. Department of Energy national laboratories; and so forth). To maximize the response rate, the survey was designed to take less than 2 minutes to complete, and it was administered by a professional online survey site (<http://www.questionpro.com>) that allowed one-time participation by those who received the invitation.

This brief report addresses the two primary questions of the survey, which contained up to nine questions (the full study is given by *Kendall Zimmerman* [2008]):

1. When compared with pre-1800s levels, do you think that mean global temperatures have generally risen, fallen, or remained relatively constant?
2. Do you think human activity is a significant contributing factor in changing mean global temperatures?

With 3146 individuals completing the survey, the participant response rate for the survey was 30.7%. This is a typical response rate for Web-based surveys [*Cook et al.*, 2000; *Kaplowitz et al.*, 2004]. Of our survey participants, 90% were from U.S. institutions and 6% were from Canadian institutions; the remaining 4% were from institutions in 21 other nations. More than 90% of participants had Ph.D.s, and 7% had master's degrees. With survey participants asked to select a single category, the most common areas of expertise reported were geochemistry (15.5%), geophysics (12%), and oceanography (10.5%). General geology, hydrology/hydrogeology, and paleontology each accounted for 5–7% of the total respondents. Approximately 5% of the respondents were climate scientists, and 8.5% of the respondents indicated that more than 50% of their peer-reviewed publications in the past 5 years have been on the subject of climate change. While respondents' names are kept private, the authors noted that the survey included participants with well-documented dissenting opinions on global warming theory.

Results show that overall, 90% of participants answered "risen" to question 1 and 82% answered yes to question 2. In general, as the level of active research and specialization in climate science increases, so does agreement with the two primary questions (Figure 1). In our survey, the most specialized and knowledgeable respondents (with regard to climate change) are those who listed climate science as their area of expertise and who also have published more than 50% of their recent peer-reviewed papers on the subject of climate change (79 individuals in total). Of these specialists, 96.2% (76 of 79) answered "risen" to question 1 and 97.4% (75 of 77) answered yes to question 2. This is in contrast to results of a recent Gallup poll (see <http://www.gallup.com/poll/1615/Environment.aspx>) that

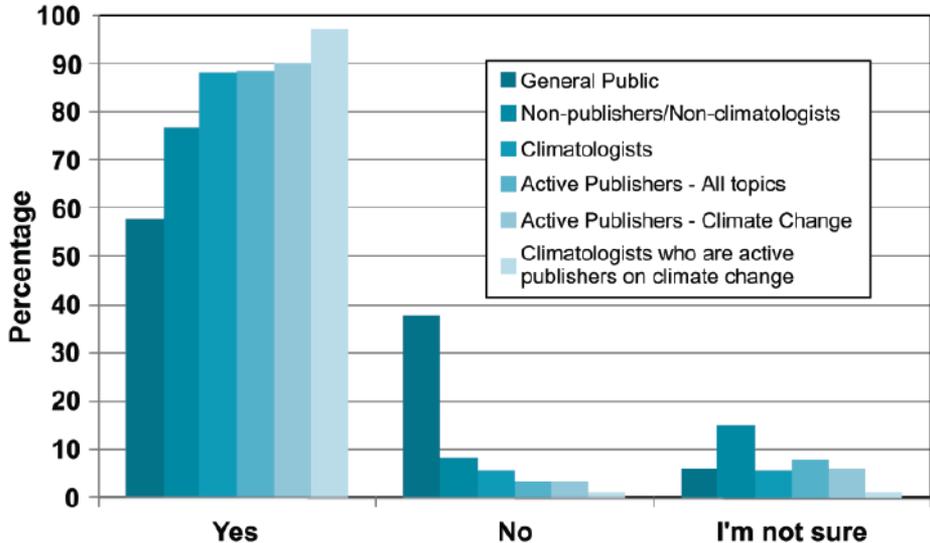


Fig. 1. Response distribution to our survey question 2. The general public data come from a 2008 Gallup poll (see <http://www.gallup.com/poll/1615/Environment.aspx>).

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suggests that only 58% of the general public would answer yes to our question 2. The two areas of expertise in the survey with the smallest percentage of participants answering yes to question 2 were economic geology with 47% (48 of 103) and meteorology with 64% (23 of 36).

It seems that the debate on the authenticity of global warming and the

role played by human activity is largely nonexistent among those who understand the nuances and scientific basis of long-term climate processes. The challenge, rather, appears to be how to effectively communicate this fact to policy makers and to a public that continues to mistakenly perceive debate among scientists.

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