THE CONSENSUS ON THE CONSENSUS:

AN OPINION SURVEY OF EARTH SCIENTISTS ON GLOBAL CLIMATE CHANGE

BY

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LIST OF NOMENCLATURE

AAPOR	American Association for Public Opinion Research
ACR	Active Climate Researcher
CO_2	Carbon Dioxide
ID	Identification
IPCC	Intergovernmental Panel on Climate Change
ISI	Institute for Scientific Information
NACR	Non-Active Climate Reseacher
Q1	Survey Question 1
Q2	Survey Question 2
Q3a	Survey Question 3a
Q3b	Survey Question 3b
Q3c	Survey Question 3c
Q4	Survey Question 4
Q5	Survey Question 5
Q6	Survey Question 6
Q7	Survey Question 7

Q8	Survey Question 8
Q9	Survey Question 9
UCS	Union of Concerned Scientists
UIC	University of Illinois – Chicago
UK	United Kingdom
URL	Uniform Resource Locator
U.S.	United States
WOS	Web of Science

SUMMARY

The major objective of this study is to collect and assess information about the opinions and attitudes of professionals within the field of geosciences (earth sciences) regarding global climate change, and the climate "consensus" debate, as well as to understand the rationale the participants use when forming their opinions by directly surveying a large number of earth scientists. In particular, this study endeavors improve on past survey attempts and provide a more rigorous dataset from which to draw conclusions on the global climate change debate.

Once survey data had been collected, the responses of various participant groups were analyzed and compared with other participant groups, as well as similar responses from the general U.S. public. This master's thesis presents the results of the survey in an effort to advance the understanding of the global climate debate among scientists.

I. INTRODUCTION

The media and general public discuss the issue of global climate regularly. A 2007 poll conducted by the Princeton Survey Research Associates International and published by Newsweek (Princeton Survey Research Associates International, Aug. 1-2, 2007) shows that only 52% of people believe that there is an agreement among scientists about the authenticity of global warming, and that only 47% believe there is agreement among scientists that human activities play a large role in the warming. This is not in agreement with the claim heard from the scientific community that there are only a small number of dissenters and that there is a broad consensus that humans are warming the planet (Oreskes, 2004a).

In separate efforts to both reaffirm the scientific consensus on global climate change, and to dispel the notion of a consensus, researchers have launched a variety of surveys designed to assess the opinions of scientists on climate change, and the role of human activity in global warming. Each survey to date has been subjected to major criticisms from both those who believe in anthropogenic-induced climate change, and those who don't. This thesis will review the origin of the debate on climate change and the scientific consensus, as well as examine the methods and shortcomings of previous survey studies, and finally present data collected using an improved survey on the opinions of earth scientists on global climate change.

The major objective of this study is to collect and assess information about the opinions and attitudes of professionals within the field of geosciences (earth sciences) regarding global climate change, and the climate "consensus" debate, as well as to understand the rationale the participants use when forming their opinions. The field of Earth Sciences was chosen as the focus of this study because it is the broad field that encompasses the study of the Earth system, including the fields of climatology and meteorology. In particular, this study endeavors improve on past survey attempts and provide a more rigorous dataset from which to draw conclusions on the global climate change debate. By creating a survey that contains very few questions, all of which lack scaled responses

options (strong agree, agree, etc.), and by administering it to a very large field of participants in a secure and controlled setting, I hope to advance the public's understanding of the global climate debate among scientists.

A. ORIGINS OF THE CLIMATE DEBATE

The Intergovernmental Panel on Climate Change (IPCC) assembles a group of scientists every 5 years to draft a consensus report on global climate change (e.g. Houghton et al, 2001; Solomon et al, 2007). These reports involve thousands of authors, contributing authors and expert reviewers and they have repeatedly stated that unequivocal warming is occurring at the earth's surface. The most recent report expresses "*very high confidence"* that human activities in industrialized times are a driving factor in that warming (Soloman et al., 2007). Yet polls like the 2007 Newsweek poll mentioned above show that many Americans still do not believe that a consensus exists in the scientific community on the issue of human-induced climate change. Media outlets, politicians, think-tanks, and special interest groups often cite uncertain science, and lack of agreement among scientists as reasons why the U.S. should not take drastic action to reduce green house gas emissions or buy into treaties that would mandate such action (Antilla, 2005).

The Union of Concerned Scientists (UCS) has suggested that ExxonMobil has run a disinformation campaign on global climate change much in the way big tobacco companies ran a disinformation campaign on the safety of smoking (Union of Concerned Scientists, 2007). Big tobacco companies have funneled money to political campaigns, lobbyists, and "science" organizations in an effort to create the image of uncertainty in science that showed smoking was hazardous to people's health (Union of Concerned Scientists, 2007). Companies with vested interest in CO_2 generating operations, like ExxonMobil, have employed systematic plans to manufacture uncertainty in the public consciousness on the validity of climate science (Union of Concerned Scientists, 2007). The UCS report, titled "Smoke, Mirrors, and Hot Air," documents early

recognition among CO_2 generating industries that if the public could be convinced that global warming was real, and was being driven by man-made greenhouse gases, they would not allow business to continue as usual, and would demand change that would greatly affect the profitability of companies like ExxonMobil. In 1989, when the public was only starting to hear they should be concerned about global warming (Meacham, 2007), ExxonMobil, along with the American Petroleum Institute and numerous other companies with interests that required the production of CO_2 (e.g. energy, automotive, and industrial companies) created the Global Climate Coalition, an organization that challenged the accuracy of climate science, and aggressively sought to highlight uncertainties that remained in climate modeling (Union of Concerned Scientists, 2007). The UCS stressed four main tactics used by ExxonMobil in their effort to make skeptics out of the public (Union of Concerned Scientists, 2007):

- *Manufacturing uncertainty:* doubt and controversy become the products that ExxonMobil was trying to sell.
- *Laundering information:* produce reports on the uncertainty of climate science, and release them through privately funded groups with names like "Global Climate Science Team," and "Center for Science and Public Policy."
- *Promoting visible scientific spokespeople:* contrarian scientists were sought out, and given large grants to promote their criticisms of current climate science.
- *Shifting the focus of the debate:* instead of talking about possible effects of climate change, the focus is shifted to talking about the lack of "sound science" or detrimental economic possibilities that could result from policy changes.

Over the last 15 years, most industries have changed their tune, now stating that environmental issues are important to them, even trying to portray a green image (e.g. BP Gasoline) (Union of Concerned Scientists, 2007). Yet in August of 2007, on the eve of the IPCC's 2007 Fourth Assessment Report on climate change, an ExxonMobil funded think-tank offered $10,000 to any scientists willing to write articles that questions the new report's findings and the data on which the

report bases its conclusions (Begley, 2007). The machine built to baffle the public's perception of the scientific consensus rolls on.

B. PREVIOUS STUDIES

The use of surveys to assess the views of scientists is by no means a new idea. Efforts to prove and disprove the apparent scientific consensus on global climate change have often taken the form of surveys of groups of scientists or of the published literature. Three major surveys (Bray & von Storch, 1997, 2003; Oreskes, 2004a; Milloy, 2007) came to very different conclusions and all sustained very different criticisms. In an effort to create a better survey that is less susceptible to criticism, it becomes important to look back at each of these four surveys and examine their purpose, results, and the critiques brought against them.

Dennis Bray & Hans von Storch – 1996 & 2003

In 1996, German researchers Dennis Bray and Hans von Storch mailed an anonymous, self-administered questionnaire to 1365 climate scientists in the United States, Canada, Germany, Denmark, and Italy in order to assess climate scientist's perspectives on global climate change (Bray and von Storch, 1997). The paper questionnaire, containing 74 questions, used a seven point rating scale to measure respondents level of agreement with a statement, or set of statements (1=strongly agree, 7 = strongly disagree). The cost-prohibitive nature of a paper survey dictated that only the questionnaire itself would be mailed to possible respondents; follow up reminders were not sent. Of the 1365 questionnaires that were mailed, 40% (564) were returned (Bray and von Storch, 2007). Responses could only be provided on the originally mailed questionnaire, ensuring that only invited climate scientists were able to respond.

In a 2003 comparison study, Bray and von Storch conducted an online survey using the 74 original 1996 questions, paired with an additional 32 questions aimed at updating issues facing

climate scientists (Bray and von Storch, 2007). Recruitment for this online survey was done by sending a link to the questionnaire to institutional lists in Germany and Denmark, by posting a message of the survey creation on the Climlist server (an international email distribution list that is moderated and used by climate scientists and other scientists in related fields), and in the Bulletin of American Meteorological Society. A message containing instructions for participation and the necessary password for survey access was included with the link sent to above organizations. No response rate data could be collected for the 2003 survey because the survey was open to all potential participants who knew where to find it and could obtain the password (Bray and von Storch, 2007). The total number of responses the 2003 online survey received was 558.

Many questions and statements in the 1996 survey dealt with ability of models to predict climate change, and asked respondents about the type of effects could result from global warming. The additional 32 questions added to the 2003 survey largely dealt with issues of adaptation to global climate change, and the perceptions of science-media interactions (Bray and von Storch, 2007). The authors conclude that their response data suggests that the matter of global climate change is "far from being settled in the scientific arena" because there is a lack of unanimous agreement on the majority of their questions.

The integrity of response collection in the 2003 Bray and von Storch survey was questioned (Lambert, 2005) when it became apparent that a post including a link to the survey, as well as the password to access it, appeared on a climate skeptics mailing list, along with a suggestion that readers complete the survey. It also enabled participants to submit more than one survey, further opening up the possibility for biased results (Bray and von Storch, 2007). In addition to the issues of sampling bias and response rate, valuation surveys, surveys in which respondents are asked to rate their feeling or agreement on topic or statement, make it difficult to assign real value to any particular choice because individuals can perceive the scale in different ways (Bray et al., 2007). Many participants may be uncomfortable "strongly" agreeing or disagreeing with a statement, and will avoid filling in extreme answers. If a researcher only considers "strong" agreement to be an agreement

with a statement, results can be skewed. For example, Bray et al. asked both 1996 and 2003 participants to rate their level of agreement with the statement "Climate change is mostly a result of anthropogenic causes." In 1996, the highest single response (20%) was 6, strong disagreement with the statement, but 40% responded with some level of agreement. The valuation system provided too many options and variable responses.

Naomi Oreskes - 2004

Oreskes (2004a) used the ISI Web of Science database, rather than individual surveys, to assess the scientific consensus on climate change. A search for the keywords "global climate change" in refereed scientific journals published between 1993 and 2003 returned 928 publications (Oreskes, 2004a). The abstract of each paper was analyzed put into one of six categories: explicit endorsement of the consensus position, evaluation of impacts, mitigation proposals, which are all considered to either explicitly or implicitly endorse the consensus position; methods, and paleoclimate analysis, which take no position on human-induced climate change; and rejection of the consensus position (Oreskes, 2004a).

Oreskes reported that 75% of all the abstracts analyzed implicitly or explicitly endorsed the consensus position on climate change, 25% of the abstracts took no stance on issue, and not a single peer-reviewed paper published between 1993 and 2003 disagreed with the consensus view. Her analysis shows that scientists who are publishing articles in peer-reviewed journals appear to agree with the IPCC consensus position (Oreskes, 2004a). While Oreskes maintains that there likely are arguments contrary to the consensus view that human activity is a driving factor in global climate change, she says, "[the arguments] are not to be found in scientific literature, which is where scientific debates are properly adjudicated" (Oreskes, 2004b)

Vociferous criticism of Oreskes' study erupted shortly after her essay (Oreskes, 2004a) was published in December of 2004. Roger Pielke Jr., from the Center for Science and Technology

Policy Research at the University of Colorado, replied to Science that he has seen claims of 11,000 abstracts on "climate change" in the ISI, and that as many as 10% of those disagree with the consensus view (Pielke, 2005). Perhaps the most outspoken critic of Oreskes' study was Benny J Peiser, a social anthropologist at James Moores University in Liverpool. Peiser claimed that his search for "climate change" on the ISI database returned nearly 12,000 publications over the same decade as the Oreskes study (Peiser, 2005a). He replicated the study and attempted to submit his results in the form of a letter to Science, but was refused. In the replicated study Peiser attempted to publish, 1117 abstracts were analyzed and put into the same six categories originally created by Oreskes plus an addition two categories: natural factors of global climate change, and unrelated to the question of recent global climate change. His results "falsified" her study by showing that 38% of abstracts implicitly or explicitly endorsed the consensus view, 13% took no stance, 3% rejected or doubted the consensus view, 4% focused on natural factors of climate change, and 42% were unrelated to the question of global climate change (Peiser, 2005a). He concludes that there was no such thing as a scientific consensus on climate change and asserted that Science should withdraw Oreskes' study in order to "prevent any further damage to the integrity of science" (Peiser, 2005a). The initial rejection sent to Peiser simply stated that his piece was too long to be considered for the Letters section of Science, and invited him to submit a revised version. The revised version was also rejected because "the basic points of [his] letter had already been widely dispersed over the internet." Dennis Bray, the German researcher who conducted a survey of climate scientists in 1996 and 2003, also wrote a letter to Science detailing the results of his study, and was also rejected (Peiser, 2005a).

Science's apparent refusal to publish Peiser's letter, Bray's study, and the studies of several other non-consensus-view climate researchers prompted an article by Robert Matthews in the UK's Telegraph accusing Science and the journal Nature of "censoring the debate on global warming" and allowing a small set of pro-global warming reviewers to invite "flawed research" that supports man-made global warming while rejecting non-consensus positions (Matthews, 2005). Spokesmen for each publication refuted these claims saying that they sought out dissenting views, providing that

they are of "acceptable scientific quality." In May of 2005, Peiser wrote an article in the Canadian National Post stating the dangers of consensus science, suggesting that those researchers who dissented from the consensus viewpoint could not get published, and would therefore not be included in reviews of peer-reviewed literature (Peiser, 2005b). Citing that fact that Bray and von Storch had submitted the results of their survey of climate scientists to Science months before Oreskes article was published, Peiser said, "It would appear that the editors of Science knowingly misled the public and world's media," and in his view, "such unethical behavior constitutes a grave contravention, if not a corruption of scientific procedures" (Peiser, 2005b)

Steven Milloy - 2007

In mid November of 2007, Steve Milloy, the editor of JunkScience.com and a known advocate for oil and tobacco companies (UCS, 2007), published the results of a six-question survey he conducted of IPCC scientists (Milloy, 2007). The press release about his study coincided with the release of the IPCC's 4th Assessment Report on climate change. Milloy emailed his survey to the 345 U.S. scientists who contributed to the 2007 IPCC report in an effort to identify the consensus on global warming among IPCC's U.S. scientists. His six questions examined individual opinions on the reasons for climate change, the role of man-made CO_2 in climate change, the impacts of controlling CO_2 emissions on global climate, and changes in the current mean global temperature. In addition, he concluded his survey with two questions that asked respondents to speculate on the climatic impacts of a 1-degree Celsius warming, and to state the "ideal global climate." Each question had five possible answers that respondents could select which essentially ranged from a strong support of the idea of anthropogenic climate change to strong opposition to the idea of anthropogenic climate change, to no opinion at all. Of the 345 scientists the survey was sent to, 28% (95 of the 345) responded, with only 54 (less than 10%) completing the entire survey (Milloy, 2007).

The results of Milloy's survey were "illuminating" by his standards (Milloy, 2007). He reported that, to the first four questions that examined the human role in climate change, the response of IPCC scientists was "Pavlovian," with 83% to 90% of participants answering that anthropogenic CO_2 emission were driving global warming and that limits imposed on CO_2 emissions were important. Responses to the last two questions in Milloy's survey, which dealt with desirability of a 1-degree Celsius increase in temperatures and the existence of an ideal climate, is where he claims to have "debunked" the scientific consensus. Participants answers varied across the board, with many refusing to provide answers, or, in the case of the final question on ideal climate, 61% said that there was no such thing. Milloy (2007) concluded that if there is no consensus over what an ideal climate is, than there is no point in taking action on global warming. In his press release, Milloy names some survey participants and attributes specific responses to them, as well as supplemented survey results with external information in an effort to support the survey's conclusions.

Criticism of Milloy's survey began before he ever published his results. Many IPCC scientists derided it as being "reckless and irresponsible" and said its purpose was deny that humans were "adding undesirable stress to natural systems" (Milloy, 2007). Brian Angliss, from www.Scholarsandrogues.com, posted an article shortly after the release of the survey results on DemandDebate.com that highlighted some of the survey's shortcomings (Angliss, 2007). Citing guidelines posted by the American Association for Public Opinion Research (AAPOR), Angliss suggests that Milloy fell short on the some of most basic steps to "ensure accuracy" in opinion polling, including failing to have specific and unbiased goal which do not favor a predetermined result, maximizing the response rate of potential participants, wording questions specifically for a the population being surveyed, and maintaining the confidentiality of individual responses.

II. METHODS

A. Survey Design

1. Basic design

The overarching design goal of this study was to attempt to directly survey a large number of Earth Scientists using a short unbiased survey that would be unobtrusive to busy people and therefore generate maximum response. The questions asked in this survey were based on a survey created by Dr. Peter Doran that was administered in his introductory geology class in the spring of 2007.

In addition to four short questions addressing the existence of climate change, its possible causes, and the presence of a scientific consensus on climate change, the survey also included a section where respondents are asked to provide basic information about themselves in order to better understand the demographic of the participant pool. In addition to collecting information on age, sex, occupation, and education, they were also asked to provide information on their publishing history, specifically the proportion of recent (last 5 years) peer-reviewed publications related to climate change. To see the survey, along with all numeric codes, please see Appendix A.

In accordance with standard suggestions made by the UIC Institutional Review Board on research involving human subjects, through the email invitation to the survey, participants were informed of the survey's purpose, the method in which their responses will be handled, the confidentiality of their responses, and were informed that their participation is entirely voluntary. To see emails sent to survey participants, please see Appendix B.

2. Addressing major criticisms of past studies

Numerous criticisms were made (Angliss, 2007; Lambert, 2005; Matthews, 2005; Peiser, 2005a, 2005b; Pielke, 2005) of past surveys that attempted to measure the scientific consensus on global climate change. Each criticism allows us to build a better survey. Listed below are eight

major criticisms of the four surveys previously discussed, along with the ways this survey attempts to address them.

- *Extensive, time consuming survey (100+ questions) discourages respondents*

  The survey has only 2 to 4 questions (dependant on previous answers) with simple predetermined answers, and 4 to 5 demographic questions. The entire survey normally takes less than 2 minutes to complete.

- *5 or 7 point valuation scales create disparity among respondents interpretation of, for example, "agree" and "strongly agree"*

  Possible answers are always, essentially, yes or no or statements. Respondents were not asked to rate their agreement with statements.

- *Survey tampering through "ballot box stuffing"*

  The online survey administration site that was used for this survey has a security feature that allows only one survey response (full survey) from a unique IP address.

- *Survey tampering through uninvited participants*

  Potential participants were sent an email through QuestionPro.com that contained a URL, which linked them directly to the online survey. A unique URL was assigned to each invited respondent, and was logged on a response recorder when they accessed the survey. No access could be gained to the survey without following the invitation URL, and once a specific email had been logged on the survey site, it could not access the survey again, even from other computers.

- *Planned effort among refereed journals to not publish dissenting, non-consensus views, and subsequent lack of dissenting views in peer-reviewed publications*

  This survey was sent to many geoscientists, regardless of publication history. It accounts for scientists that are and are not able to publish in refereed journals. Publication history was accounted for in demographics, but did not preclude respondents from participating. In fact, the list contained a number of known climate change skeptics

- *Lack of specific goals when designing the survey, or goals that favor a predetermined result*

  The survey was designed to minimize bias. Questions were all worded to maintain as much neutrality as possible while using language appropriate for the surveys demographics. The main goal was simply to produce a dataset that represents the opinions of a large number of earth scientists.

- *Potential response rates not maximized*

  Using the largest accessible list of geoscientists available and sending email invitations to all potential participants maximized the survey's response rates.

- *Confidentiality of all respondents and responses not maintained*

  Confidentiality of respondents and individual responses was and continues to be aggressively maintained. While responses were initially tracked via email addresses and IP addresses in order to prevent survey tampering, once data is made public, all responses will be dissociated from individual email address, and identified only by a participant ID assigned to each participant by QuestionPro upon survey completion.

3. Identifying participants / establishing a population

In an effort to find a large pool of names of geoscientists and their contact information, two of the largest geoscience societies were contacted. Both the Geologic Society of America (20,000+ members), and the American Geophysical Union (50,000+ members) declined to give out membership directories, citing an understandable expectation of confidentiality from their members. Names for these sources would have allowed us to survey a large population of scientists with diverse backgrounds in both academia and the professional world. The search for a large database of contact information for geoscientists continued until an accessible source was found.

The American Geological Institute, a "nonprofit federation of 44 geoscientific and professional associations that represents more than 100,000 geologists, geophysicists, and other earth scientists" publishes a yearly directory of geoscience departments (Keane and Martinez, 2007). The second half of the book contains a faculty directory that includes the name, telephone number, email address, university, and research specialty of every faculty member from reporting geoscience departments. This faculty directory also includes contact information for employees of state geologic surveys that are associated with local universities. In total, the directory contains over 12,000 names. While this does not allow us to survey geoscientists who work for private industries or private research institutions that have no university affiliation, it does provide the largest database of names

of geoscientists that was feasible to obtain. For statistical purposes, the population that this survey will comment on will be academics, or those associated with college and university programs in the geoscience field in 2007.

An electronic version of the directory was not available, so the directory pages were cut from the bound book, and fed into a document scanner, which digitized the lists on each page into text files. The text files were then manipulated and corrected and finally organized into a list of email addresses from the book. Some names in the book did not have email addresses associated with them and so those individuals are not represented.

B. Survey administration

Several possible approaches were initially considered when deciding on the mode of survey administration. The high volume of surveys being sent out meant that an automated system would be more efficient, and would cut down on the possibility of human-error. After comparing multiple online survey creation websites, QuestionPro was chosen. QuestionPro offers a streamlined automated system for uploading participant contact information, collecting survey responses, and exporting data to Excel. QuestionPro provides a secure site for managing surveys, and has a variety of methods for safeguarding against ballot box stuffing and uninvited respondents.

The type of survey created for this study is considered to be an email URL embedded closed-web questionnaire (Bradley, 1999). Each prospective subject was contacted via email and invited to participate in this study through an online survey. The participants received an email from mkenda2@uic.edu, but the message was actually sent through the QuestionPro.com website, making it possible to track whether or not an invited participant had responded yet, and also allowed reminder emails to be sent to potential participants who had not responded within set time periods. The email contained a link to the online survey site QuestionPro.com, and only allowed invited participants to respond, and individuals to respond only once.

Voluntary consent to surveying was obtained through the email invitation that each potential participant received (Appendix B). The invitation explained who the researcher is, the purpose of the survey, an estimation of time to complete the survey, along with an explanation of how their responses will be stored, the voluntary nature of their participation, and an assurance of confidentiality. By clicking the link to the survey, participants provided consent to participate. Contact information for the PI was also included, as well as an offer to make final aggregate survey results available upon request.

A completion ID number identifies individual survey responses. Response data is stored on a password protected section of the QuestionPro website, accessible only to the investigators. All response data will be deleted from the QuestionPro website upon completion of this study. Responses will also be stored on the office computers of the investigators, all of which are password protected and are used only by their respective owners. Undergraduate research assistants and other faculty members may also access the response data, which would include answers to questions, along with demographic information, but not names. Response data will be stored indefinitely on investigator's personal computers for future reference.

The survey was online for two weeks. The high volume of potential participants left open the possibility that responses could trickle in over the course of months, and that was not conducive to the timeline of this project. Below is the timeline of the survey:

April 3rd, 2008, AM:

Survey goes online, email invitations are sent to 10,000+ potential participants

April 9th, PM:

Reminder emails are sent to all potential participants who have not yet responded

April 15th, AM:

Second reminder email is sent to all potential participants who have not yet responded

April 17th, PM:

Survey taken offline and no more responses are accepted.

C. Data Handling

1. Coding

Comprehensive survey data was exported from QuestionPro into Excel shortly after the survey was taken offline. All data was exported in text form and needed to be coded into numeric form for data analysis. Each question was assigned a code (Q1, Q2, etc), and each possible response for each question was given an option number (1, 2, 3, etc.) (see Appendix A for survey questions and codes). This was done using the find and replace function in Excel. In the master dataset, participants are identified with a six-digit ID number, and their responses are recorded down the row for each question.

2. Categorizing write-ins

Questions 3a, 3b, and 3c, along with questions, 4, 6, 8, and 9, had a section where respondents could write in their answers. These write-ins were analyzed, and entered into existing categories when appropriate. In questions 3a, 3b, 4, and 9, new categories were created to accommodate the wide range of write-in responses. In question 3b, one category was added to account for participants who considered a combination of the three arguments compelling. In question 4, a category was added to account for the many participants who wrote in percentages that varied between 95 and 99.99%. In question 9, the expertise questions, the original survey had 13 choices, and a section for write-ins. Ultimately, write-ins accounted for more than 20% of the total responses; so 12 additional categories were added for a total of 25 categories. To see all write-ins for Q3a, please see Appendix C; for Q3b write-ins please see Appendix D, and for Q4 write-ins, please see Appendix E.

3. Verifying publication claims to establish error rate

Those who claimed to have over 50% of their peer-reviewed publications in the area of climate change over the last five years (a response of 2 on Q5) are, for the purposes of this study, considered an expert population in the field of climate science. They are referred to as "active climate researchers" (ACRs) in this paper. It became apparent early on in the survey process that, because emphasis would be placed on the answers given by this particular group of respondents, it would be necessary to fact check those claims.

When a respondent was found to have claimed over 50% of their publications in the area of climate change, their email address was recorded, along with their survey completion ID and their response to Q5. The email address was matched to a name of the respondent, and those two pieces of information were used to run an Internet publication search. The participant's personal web page was accessed, along with a search of their publications on ISI WOS. If it was possible to verify that the participant did indeed have a proportionally significant number of climate-related publications, the respondent was checked off a list. If it was apparent that the participant did not have a record of publishing on climate change in peer-reviewed publications, their ID was noted. This judgment was reserved for extreme cases which could be classified as blatantly fraudulent answers. It is important to note that while verifying respondent's publication claims, their survey responses were not associated with their names and email addresses so as to remove any possible judgment bias (i.e. all those indicating they had published more than 50% of the peer-reviewed publications in the last five years on the subject of climate change were treated equally in this judgment regardless of how they answered in the rest of the survey).

Altogether, 267 participants responded that over 50% of their peer-reviewed publications in the last five years were on the subject of climate change. Of those 268, 243 were found to have made an accurate claim. In some cases, these participants had no publication history at all since their Ph.D. theses, in some cases they had some published papers, but nothing that would fall into the category of climate change, and in other cases, participants had perhaps one or two publications in

the area of climate change, but had not published on the issue anytime in the past decade. It is impossible to know the motivation behind these inaccurate responses, but likely reasons include inadvertent answer selection that did not reflect their intended answers, misinterpretation of the question, or an attempt to mislead the researchers.

The online survey administration and data tracking site that was used for this survey, QuestionPro, repeatedly calculated standard error at 0.01 for each question data set. The error calculated using the specific example of false publication history claims is 0.76.

4. Removing incomplete responses

Upon closing, the survey had generated 3369 responses. Responses that indicated the time to complete the survey was "0" were all deleted, as a "0" indicated that the participant had closed the survey before reaching the final pages, therefore not viewing the entire survey. Additionally, participants that clicked through the whole survey, but failed to respond to more than two questions were also removed from the master dataset. In one case, a participant was removed because all responses had been written in a comical fashion and had nothing to do with the survey itself. In total, 219 participant response sets were deleted due to the incomplete nature of their responses.

5. Removing responses from non-geoscientist

After the survey was initially sent out, several emails were received from departmental administrative assistants who had been sent a survey invitation and did not believe they qualified as participants. Because the survey was clearly reaching several recipients who would not qualify as geoscientists, it was necessary to comb through the expertise category in Q9 and determine if any other administrative assistants or other non-geoscientist had taken the survey. In total, three self-identified administrative assistants were removed from the master dataset, along with three librarians, and twelve others who identified themselves as IT support personnel or of another

profession not associated with the geosciences. The final master dataset contains 3146 survey participant response sets.

D. Data analysis

At the survey closing time, a comprehensive survey report was generated using QuestionPro, and was exported into Microsoft Excel and was coded to reflect the numeric codes indicated on the survey (Appendix A). Once in Excel, incomplete response sets were removed from the master dataset, and inaccurate responses given to Q5 were corrected. The Excel data set includes the following: survey completion ID, Internet IP address, Survey completion time, Country code, Region code, Q1, Q2, Q3a, Q3b, Q4, Q5, Q6, Q7, Q8, Q9, and the written responses to Q3c. Each category has a numeric code to indicate answers given.

III. RESULTS

A. Basic Demographics

The final number of survey participants was 3146, which is greater than a 30% response rate when our target was greater than 10% (pers. comm. with Karen Retzer, 09/06/2007). Of those 3146, the vast majority responded to every question asked. Not every single participant responded to every single question, so in some of the data counts, the responses do not always add up to 3146.

1. Location

90% (2833) of respondents were from the United States, while the remaining 10% (313) came from 22 other countries (Figure 1). Respondents from Canada accounted for 62% of the international responses. The following countries account for 1% - 7% of the international responses: Great Britain/UK (7.3%), Germany (6.4%), Australia (4.8%), Spain and New Zealand (2.9%), France (2.2%), Japan (1.6%), and Austria, Switzerland, and Malaysia (1.3%). The following countries accounted for less that 1% of the international respondents: China, Puerto Rico, Turkey, Mexico, Taiwan, Belize, Chile, Cyprus, Ireland, Norway, and Sweden.

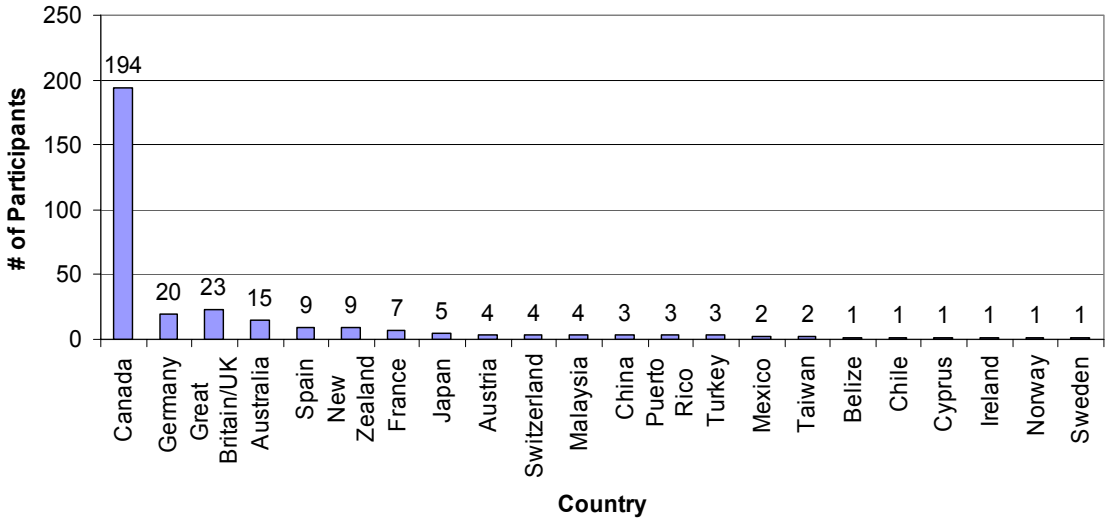

Figure 1. International participant distribution by country.

From the U.S., respondents from California accounted for the largest percentage (9%) (Figure 2). Texas, New York, and Pennsylvania accounted for roughly 5% each. Other states with large universities, such as Washington, Illinois, Massachusetts, Ohio, Wisconsin, and Colorado, accounted for approximately 3% each, with all other states ranging from 2.5% to 0.2%.

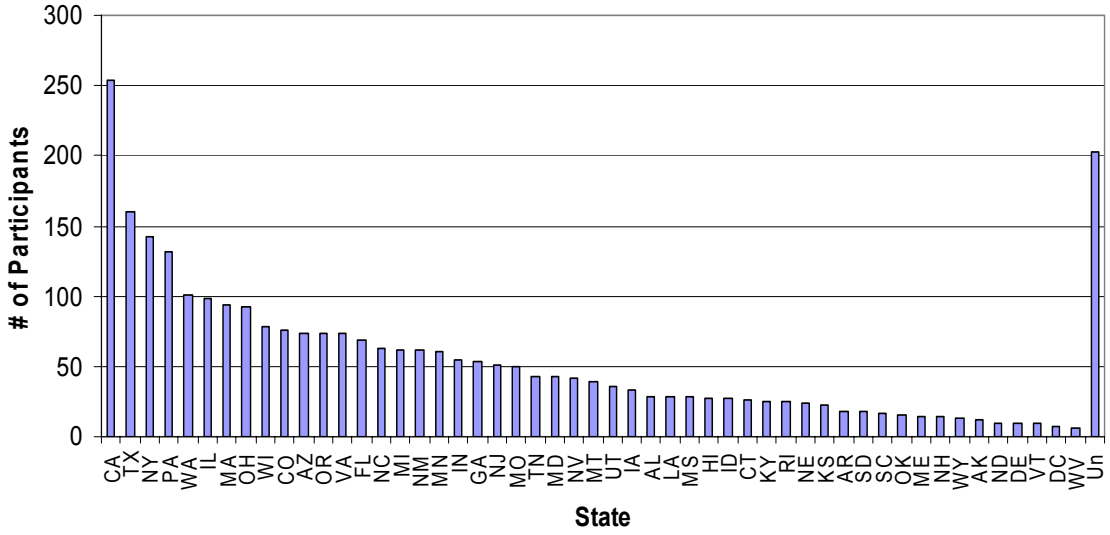

Figure 2. U.S. participant distribution by state.

2. Other demographics

Cumulative age data followed a normal distribution, with ~85% of participants reporting their ages to be between 36 and 65 (Figure 3). 21% fall into the 36-45 range, 35% fall into the 46-55 range, and 25% fall into the 56-65 range. Participants who are less than 35 years old make up only 4.6% of the survey respondents, while those over 65 make up 12.5% of the respondents.

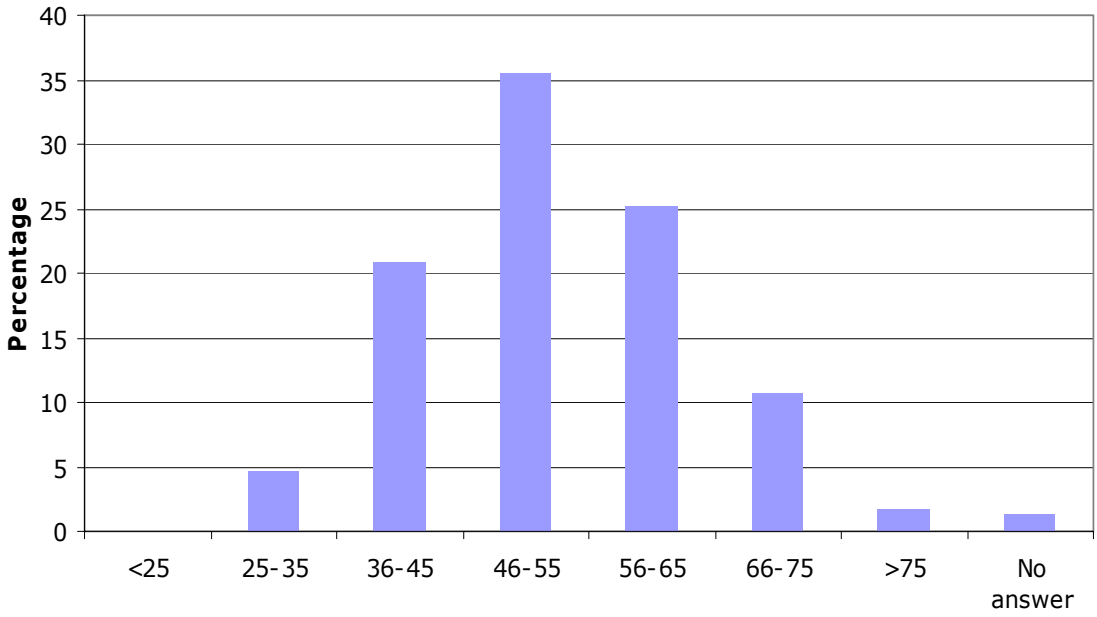

Figure 3. Age distribution of survey participants.

As is often reflected in the geosciences (Martinez, 2008), the gender distribution among the survey participants is far from equal. 80.4% of participants were men, 17.7% were women, and 1.8% declined to provide an answer (Figure 4).

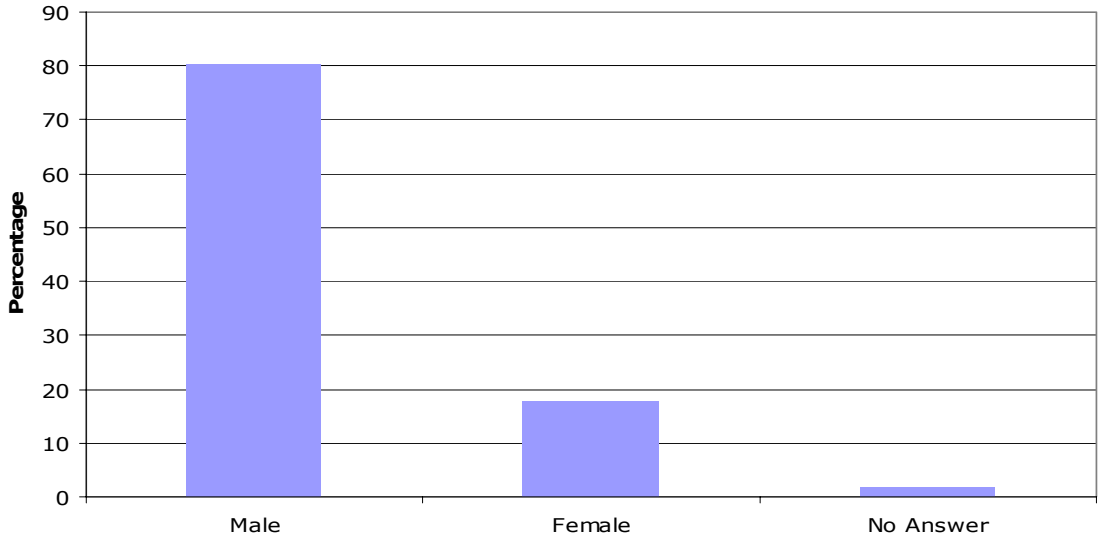

Figure 4. Gender distribution of survey participants.

The vast majority of survey participants (91.4%) listed a Ph.D. as their highest level of education. 6.7% listed a Master's degree as their highest level of education. The remaining ~2% have a Bachelor's degree, some graduate school, an M.B.A, and another type of professional degree (Figure 5).

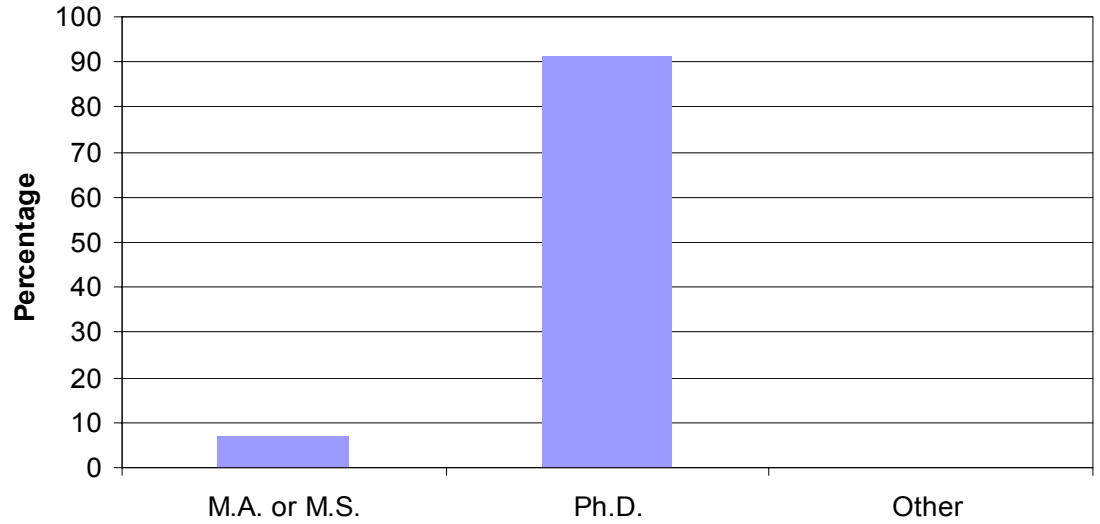

Figure 5. Education level distribution of survey participants, (Other = High school or equivalent, Some college, Associates degree, B.A./B.S., Some graduate school, M.B.A., M.D.).

The areas of expertise varied greatly. The most common expertise reported were geochemistry (15.5%), geophysics (12%), and oceanography (10.5%). General geology, hydrology/hydrogeology, and paleontology each account for 5-7% of the total respondents as well (Figure 6).

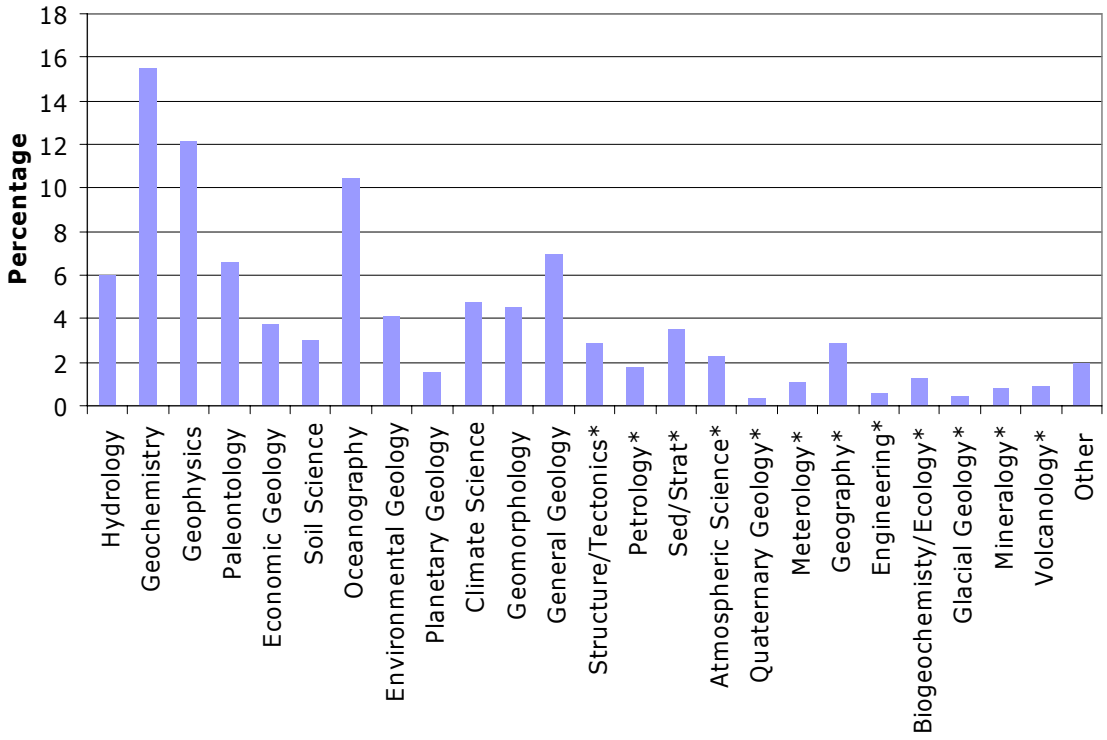

Figure 6. Area of Expertise distribution of survey participants. (Asterisks denote categories created to accommodate write-ins).

Among the cumulative survey respondents, ~8.5% of participants had published more than 50% of their peer-reviewed publications in the last five years on the subject of climate change. 48% of the respondents published less than 50% of the peer-reviewed papers in the last five years on the subject of climate change, and 43.3% reported that the question was not applicable to them (Figure 7). The remaining 2% of the respondents did not give an answer.

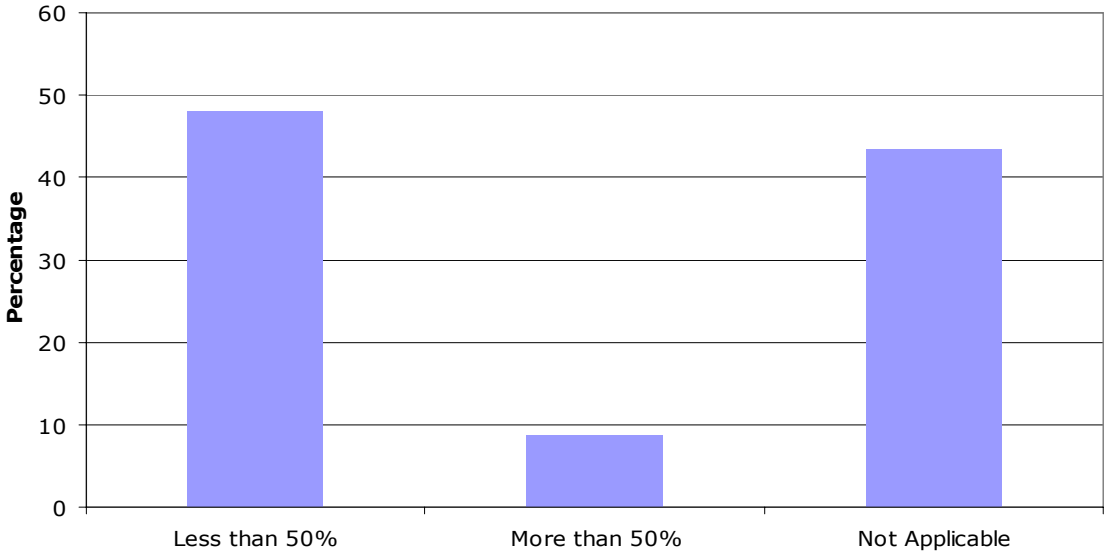

Figure 7. Publication history distribution of survey participants. Response to question, "What percentage of your peer-reviewed publications in the last five years have been on the subject of climate change?"

B. Responses to Survey Questions

Q1: "When compared with pre-1800's levels, do you think that mean global temperatures have generally risen, fallen, or remained relatively constant?" Of the total survey participants, 89.5% thought that mean global temperatures had risen (option 1), 0.5% thought they had fallen (option 2), 5.7% thought they had remained relatively constant (option 3), and 4.2% had no opinion (option 4) (Figure 8).

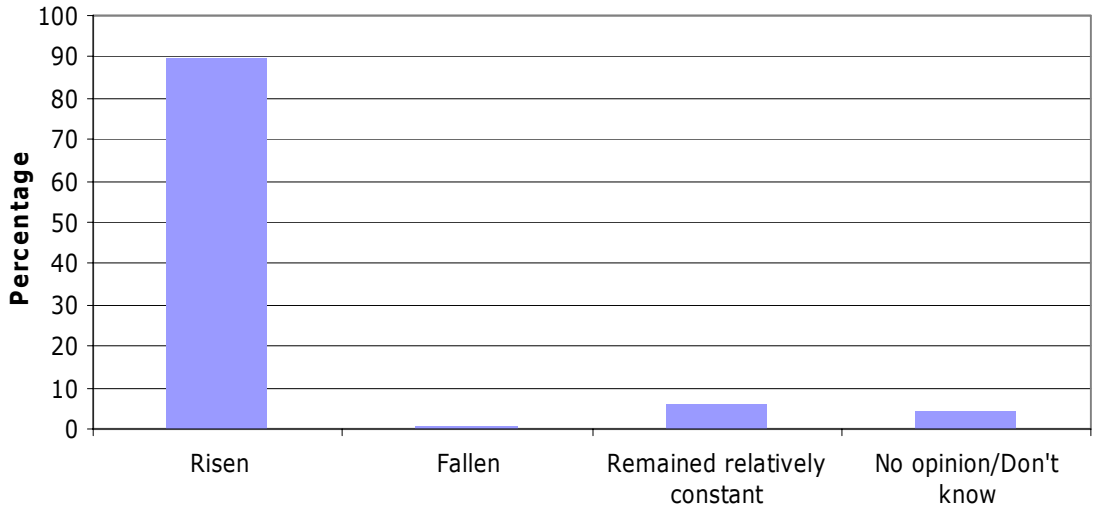

Figure 8. Response distribution of survey participants to Q1, "When compared with pre-1800's levels, do you think temperatures have generally risen, fallen, or remained relatively constant?"

Q2: "Do you think human activity is a significant contributing factor in changing mean global temperatures?" 82% of the survey respondents thought that human activity was a significant contributing factor (option 1), 6.7% thought it was not a significant contributing factor (option 2), and 11% were unsure if human activity was a significant factor (option 3) (Figure 9). Participants who said they were unsure were directed to Q3c, a prompt asking them to please write in what made them unsure. Of these participants, many said that they believed humans were a factor, but were not sure how significant. Others said the issue was too complex to easily answer the question. Still others felt that they had not reviewed the data thoroughly enough to comment on the significance of human activity in changing temperatures. For a full list of responses to Q3c, please see Appendix F.

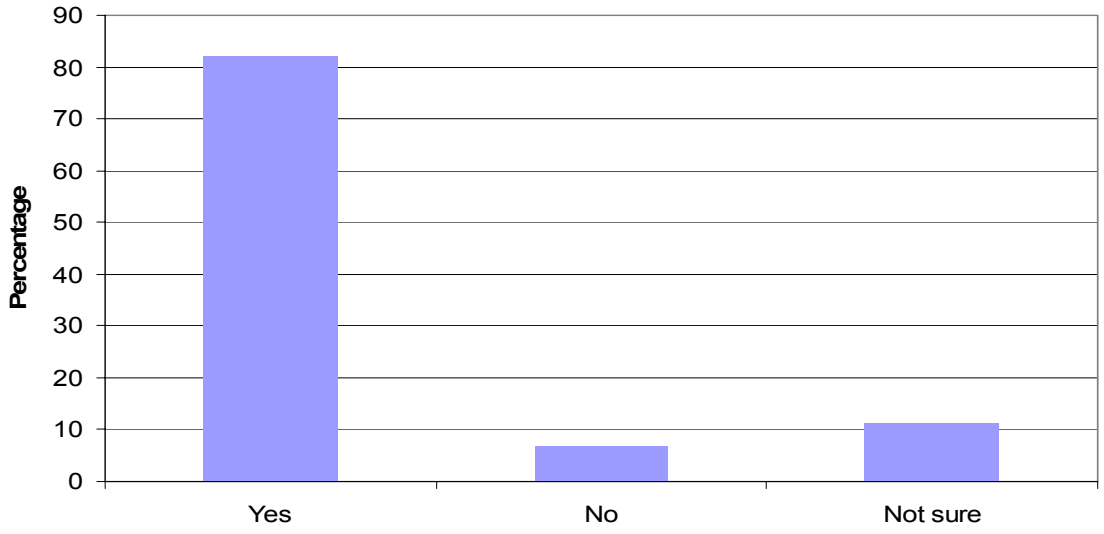

Figure 9. Response distribution of survey participants to Q2, "Do you think human activity is a significant contributing factor in changing mean global temperatures?"

Q3a: If participants responded that they do believe human activity is a significant factor in changing mean global temperatures, they were directed to question 3a, which asked, *"What do you consider to be the most compelling argument that supports your previous answer (that human activity IS a significant factor is changing mean global temperatures)?"* While there were originally four possible categories, the write-in categories expanded the count to 12 categories. Of the responses, 72.5% chose "the coupled change in atmospheric CO_2 and average global temperature" (option 1). "The rate of glacial and sea ice melt" (option 2) was chosen by 11.3% of the respondents. 4.8% chose some combination of two or all of options 1, 2, and 3 (option 4) (Figure 10). All other options each accounted for less than 3% of the cumulative responses.

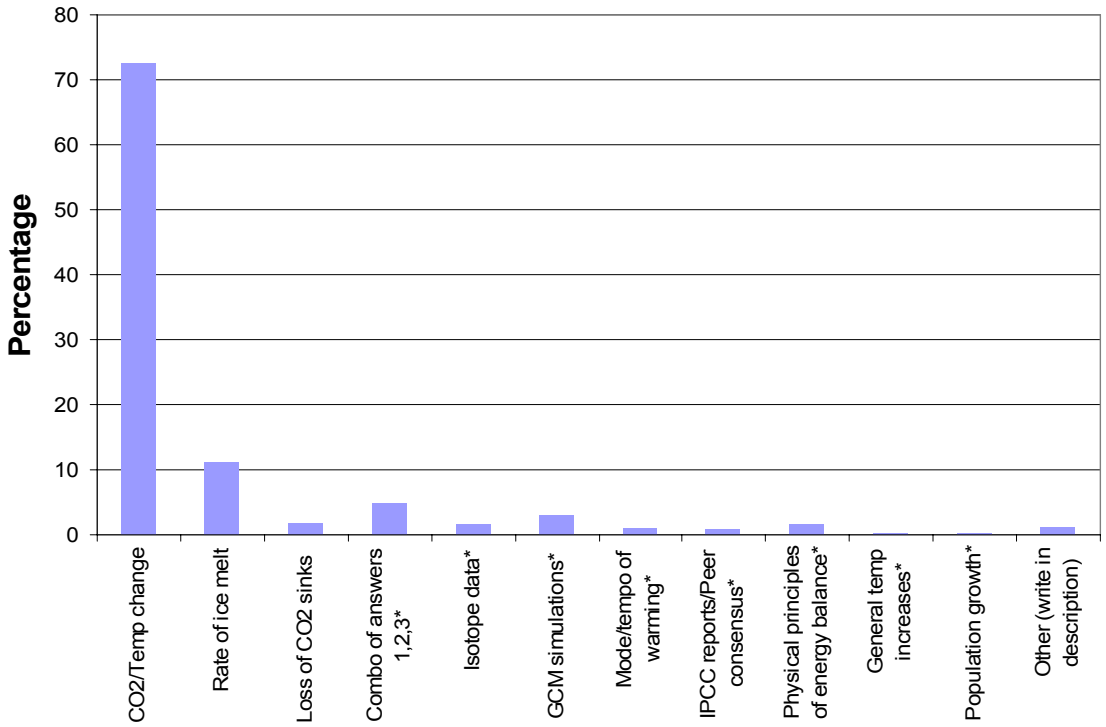

Figure 10. Response distribution of survey participants to Q3a, "What do you consider to be the most compelling argument that supports your previous answers (that human activity IS a significant contributing factor to changing temperatures)?" (Asterisks denote categories created to accommodate write-ins).

Q3b: If participants responded that they do not believe human activity is a significant factor in changing mean global temperatures, they were directed to question 3b, which asked, *"What do you consider to be the most compelling argument that supports your previous answer (that human activity IS NOT a significant factor is changing mean global temperatures)?"* 53.5% of respondents chose "natural climate cycles" (option 1), 27.9% chose "increased solar input in recent years" (option 2), and 5.2% chose "unreliable temperature records" (option 3) (Figure 11). The single category – some combination of two or all options 1, 2, and 3 – was added, and accounted for 9.5% of the cumulative responses (option 4).

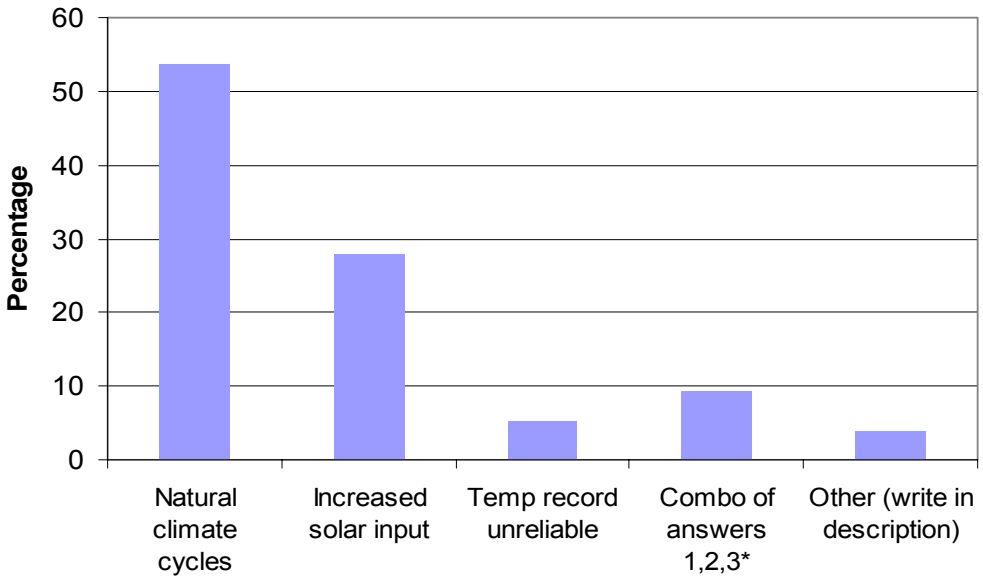

Figure 11. Response distribution of survey participants to Q3b, "What do you consider to be the most compelling argument that supports your previous answer (that human activity is NOT a significant contributing factor to changing global temperatures?)" (Asterisk denotes category created to accommodate write-ins).

Q4: Question four asked participants to, *"Please estimate the percentage of your fellow geoscientists who think human activity is a contributing factor to global climate change."* The average response was 80%. 5% of participants thought less than 50% of their colleagues believed that human activity was a factor in global climate change (Figure 12). 22.6% estimated that between 50% and 70% of their colleagues believed that human activity was a factor in global climate change. 20.5% estimated that 80% of their colleagues believed that human activity was a factor in global climate change, 34.7% estimated that 90% of their colleagues believed that human activity was a factor in global climate change, and 10.4% estimated that 100% of their colleagues believed that human activity was a factor in global climate change. Due to a large number of write-ins, a category for 95% or more of their colleagues was added, which accounted for 5.4% of the cumulative responses. Another 1.3% responded that they were unsure of the percentage of their colleagues believe that human activity was a factor in global climate change.

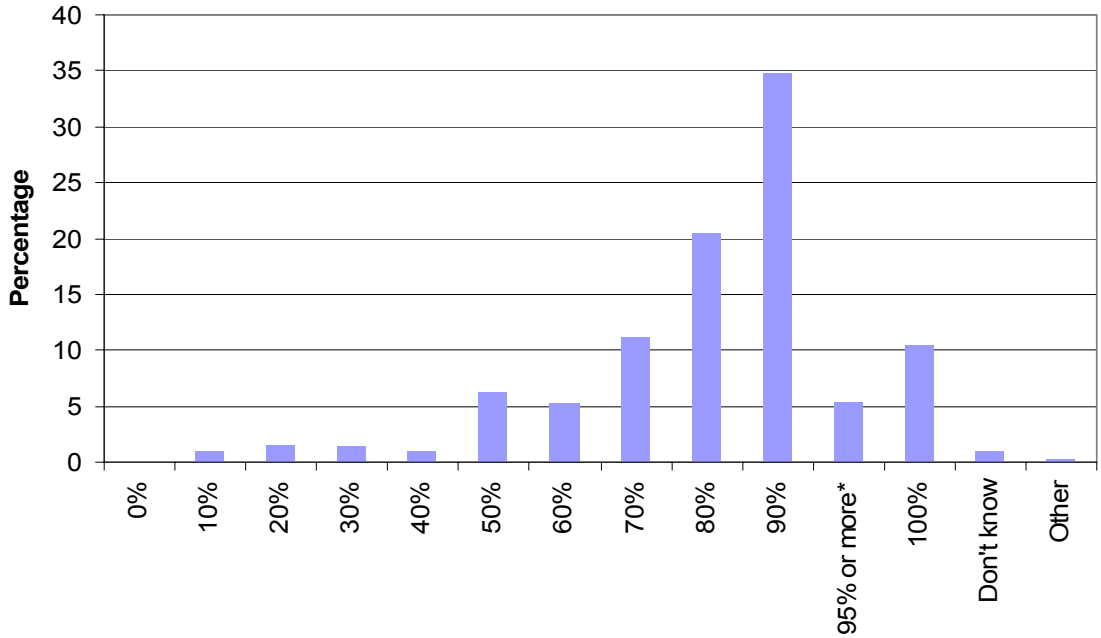

Figure 12. Response distribution of survey participants to Q4, "Please estimate the percentage of your fellow geoscientists who think human activity is a contributing factor to global climate change." (Asterisk denotes category created to accommodate write-ins.)

C. U.S. v. International Responses

1. Demographics

The demographics of the U.S. and international participants were very similar. Notable differences include a five percent drop in the number of U.S. participants between the ages of 36-25 (18%) when compared with international participants in that same age group (23.7%) (Figure 13). The gender distribution shows no significant differences. Education levels vary some. The U.S. PhD's account for 88% of the U.S. respondents, while the international PhD's make up 95% of international respondents. The U.S. survey participant group also has roughly 5% more participants with Master's degrees than the international survey participant group. The percentages of participants in particular areas of expertise are largely similar for both the U.S. and the international respondents, as are the publication histories of both groups. A slightly higher percentage of international respondents (9.8%) have published more than 50% of their recent peer reviewed publications on the subject of climate change when compared with their U.S. counterparts (7.6%).

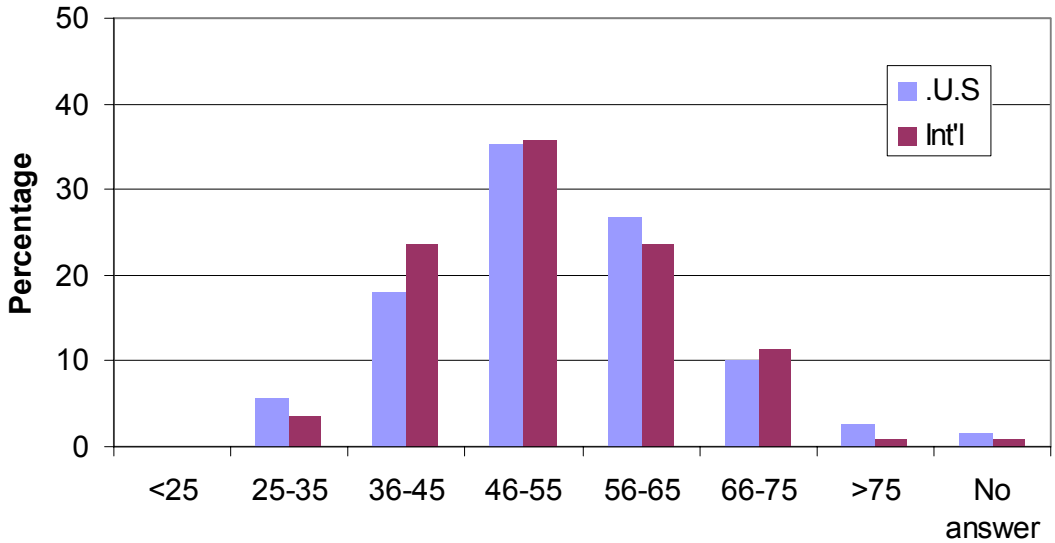

Figure 13. U.S. vs. International age distribution.

2. Comparative responses to survey questions

Q1: "When compared with pre-1800's levels, do you think that mean global temperatures have generally risen, fallen, or remained relatively constant?" Slight differences exist in the way international and U.S. respondents answered Q1. 87.8% of international respondents thought that global mean temperatures had risen when compared with pre-1800's level (option 1), while 91.2% of U.S. respondents thought the same way. Very similar percentages from both participant groups thought that temperatures had fallen (option 2), and roughly 2% more international respondents thought temperatures had remained relatively constant when compared with U.S. respondents (option 3) (Figure 14).

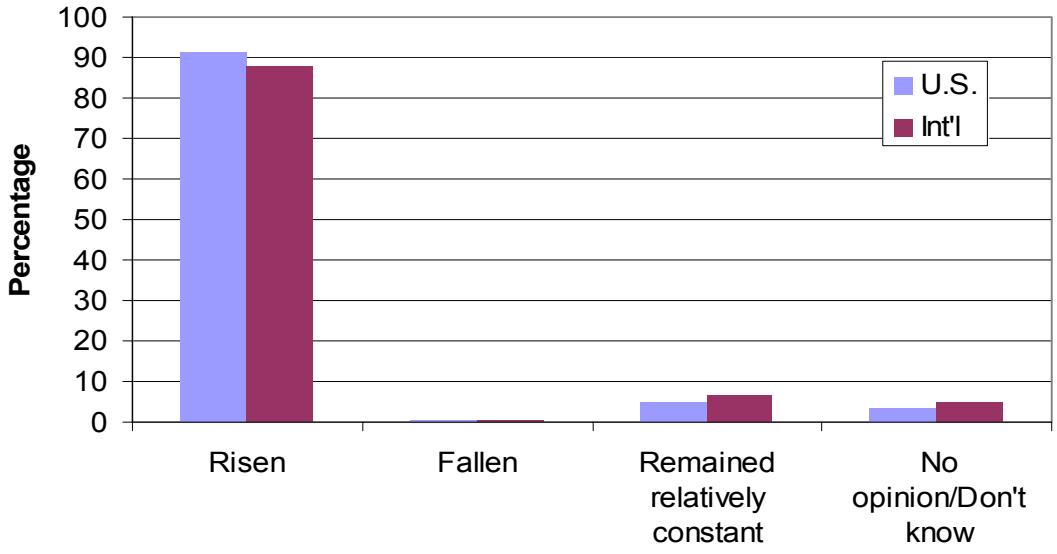

Figure 14. U.S. vs. International response distribution to Q1, "When compared with pre-1800's levels, do you think temperatures have generally risen, fallen, or remained relatively constant?"

Q2: "Do you think human activity is a significant contributing factor in changing mean global temperatures?" For question 2, the same percentages of U.S. and international participants were unsure that human activity was a significant contributing factor to changing global temperatures (option 3), 83.8% of U.S. participants thought the human factor was significant (option 1), while 80.4% of international participants thought the same way. 5.3% of U.S. participants said human activity was NOT a significant factor in changing global temperatures (option 2), while 8.25% of international participants responded that human activity was not a significant driving factor (Figure 15).

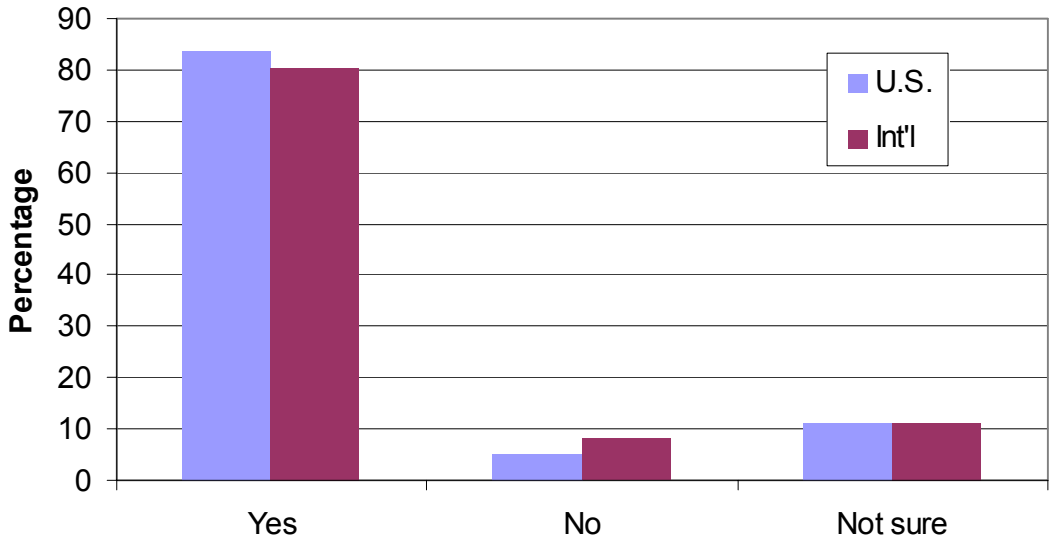

Figure 15. U.S. vs. International response distribution to Q2, "Do you think human activity is a significant contributing factor in changing mean global temperatures?"

Q3a: If participants responded that they do believe human activity is a significant factor in changing mean global temperatures, they were directed to question 3a, which asked, *"What do you consider to be the most compelling argument that supports your previous answer (that human activity IS a significant factor is changing mean global temperatures)?"* Arguments for why humans are a significant driving factor in global climate change were similar in all categories but two. 74.2% of U.S. participants, compared to 71% of international participants answered "the coupled change in atmospheric CO_2 and increasing temperatures" (option 1). 9.6% of U.S. participants responded with "the rate of glacial and sea ice melt" (option 2), while 12.8% of international respondents answered the same way (Figure 16).

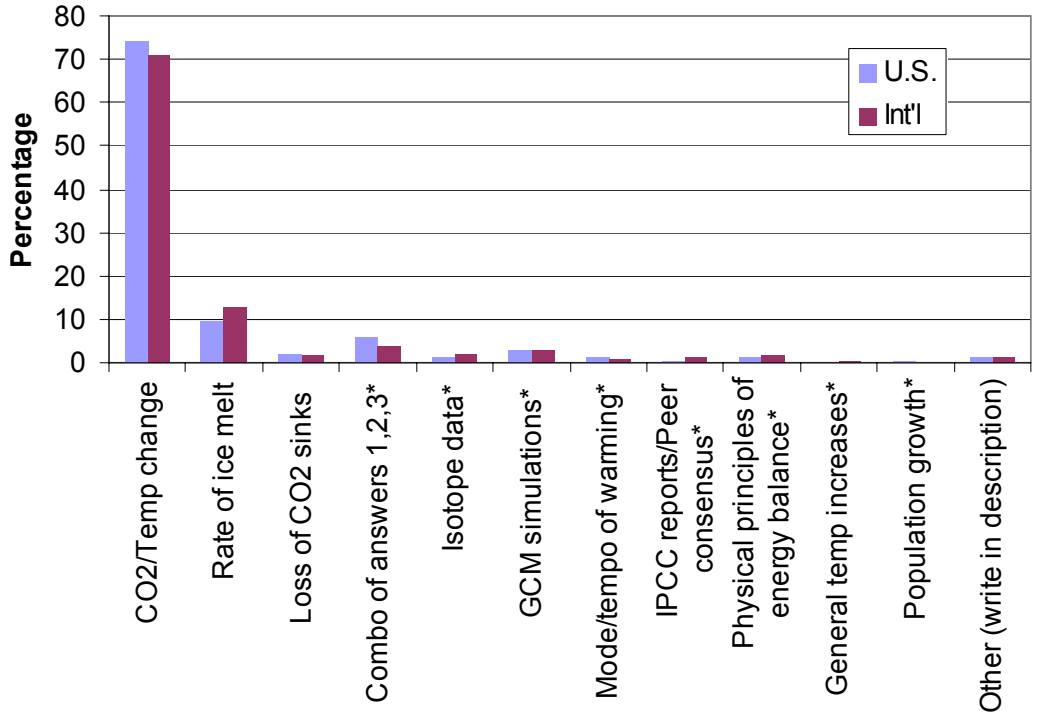

Figure 16. U.S. vs. International response distribution to Q3a, "What do you consider to be the most compelling argument that supports your previous answers (that human activity IS a significant contributing factor to changing temperatures)?" (Asterisks denote categories created to accommodate write-ins).

Q3b: If participants responded that they do not believe human activity is a significant factor in changing mean global temperatures, they were directed to question 3b, which asked, *"What do you consider to be the most compelling argument that supports your previous answer (that human activity IS NOT a significant factor is changing mean global temperatures)?"* Percentages varied widely in this particular response set, likely due to the small number of responses. 50% of international respondents and 57% of U.S. respondents chose "natural climate cycles" (option 1). 37.5% of international respondents and 18.3% of U.S. respondents chose "increased solar activity" (option 2). 0% of international respondents and 10.5% of U.S. respondents chose "unreliable current or reconstructed temperature records" (option 3). Finally, 8.3% of international respondents and 10.5% of U.S. respondents chose an added category that accounted for the participants who responded that a combination of options 1, 2, and 3 was their choice (option 4) (Figure 17).

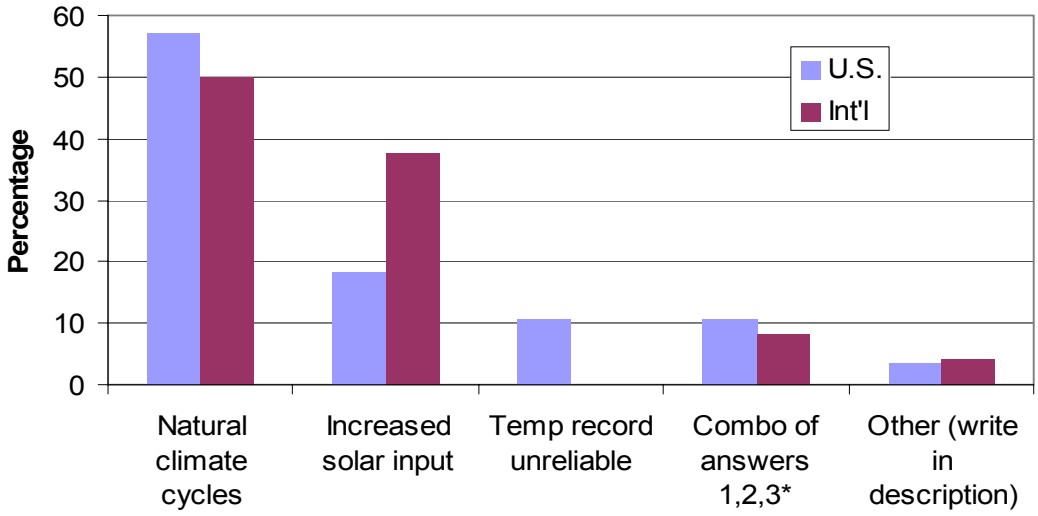

Figure 17. U.S. vs. International response distribution to Q3b, "What do you consider to be the most compelling argument that supports your previous answer (that human activity is NOT a significant contributing factor to changing global temperatures?)" (Asterisk denotes category created to accommodate write-ins).

Q4: Question four asked participants to, *"Please estimate the percentage of your fellow geoscientists who think human activity is a contributing factor to global climate change."* U.S. and international responses followed a very similar distribution on question 4, which asked them to estimate the percent of their fellow geoscientists who believed that human activity was a factor in changing temperatures. There was no departure of more than 3% for any option between U.S. and international participants (Figure 18).

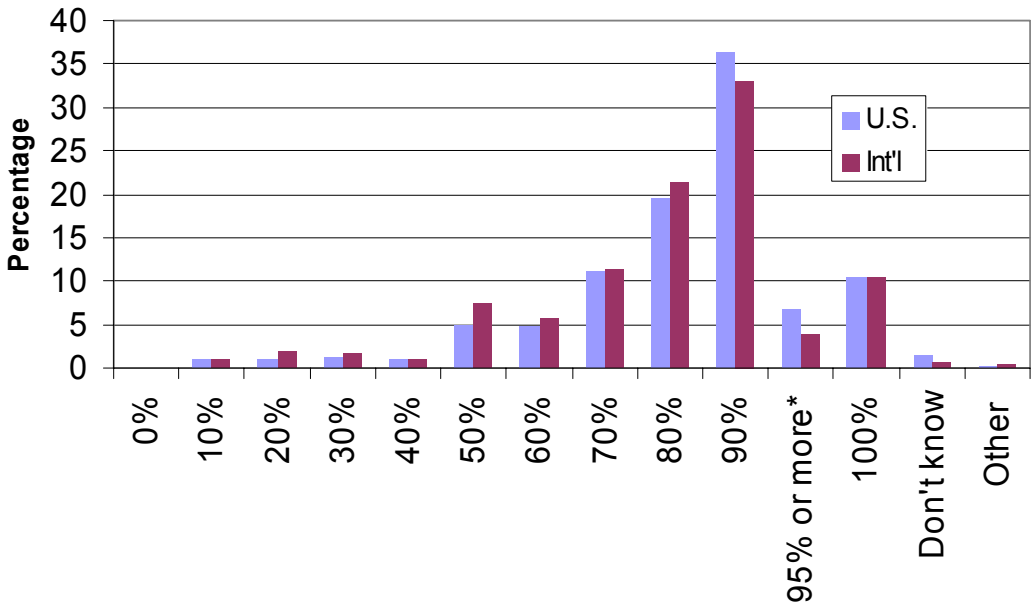

Figure 18. U.S. vs. International response distribution to Q4, "Please estimate the percentage of your fellow geoscientists who think human activity is a contributing factor to global climate change." (Asterisk denotes category created to accommodate write-ins.)

D. Active Climate Researcher vs. Non-active Climate Researcher Responses

For the purposes of this study, active climate researchers (ACRs) are considered to be any participant who, by choosing option 2 on Q5, indicated that they have published more the 50% of their peer-reviewed publications in the last five years on the subject of climate change (n=244). Non-active climate researchers (NACRs) are participants who chose option 1 or 3 on Q5, indicating that less that 50% of the recent peer-reviewed publications in the last five years were on the subject of climate change, or that the question was not applicable to them.

1. Demographics

The age distribution among active climate researchers (ACRs) shows marked differences when compared with the age distribution of non-active climate researchers (NACRs). ACRs tend to be younger than NACRs, evidenced by the fact that while 36.5% of ACRs are between 25 and 45 years old, only 23% of NACRs fall into the same category (Figure 19). Likewise, NACRs, ages 56 and older, account for 39.5% of NACR, while ACRs in the same age group only account for 30.6% of the ACR group. The gender distribution is nearly identical between ACRs and NACRs. A higher percentage of ACRs have PhD's (94.38%) than their NACR counterpart (88%). Not surprisingly, a much higher percentage of ACRs list their area of expertise as Climate Science (30.5%) than do NACRs (2.3%). Another marked difference was in the area of oceanography/marine geology, where 18% of ACRs indicated their expertise, while only 9% of NACRs answered that way.

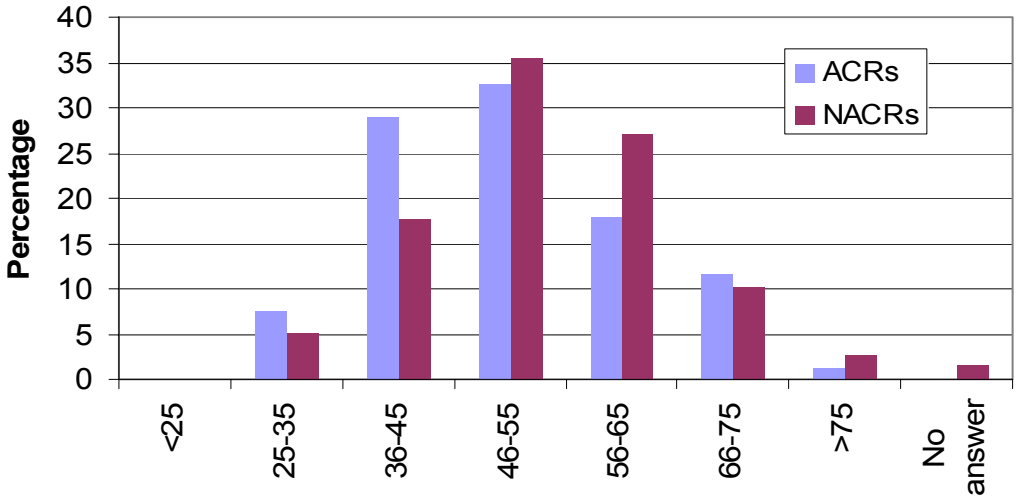

Figure 19. ACR vs. NACR age distribution.

2. Comparative responses to survey questions

Q1: "When compared with pre-1800's levels, do you think that mean global temperatures have generally risen, fallen, or remained relatively constant?" When asked this question, 90.6% of NACRs responded that temperatures had risen (option 1), while 94% of ACRs gave the same answer. 0.8% of ACRs believed temperatures had fallen (option 2), very similar to the 0.4% of NACRs that believed temperatures had fallen (Figure 20).

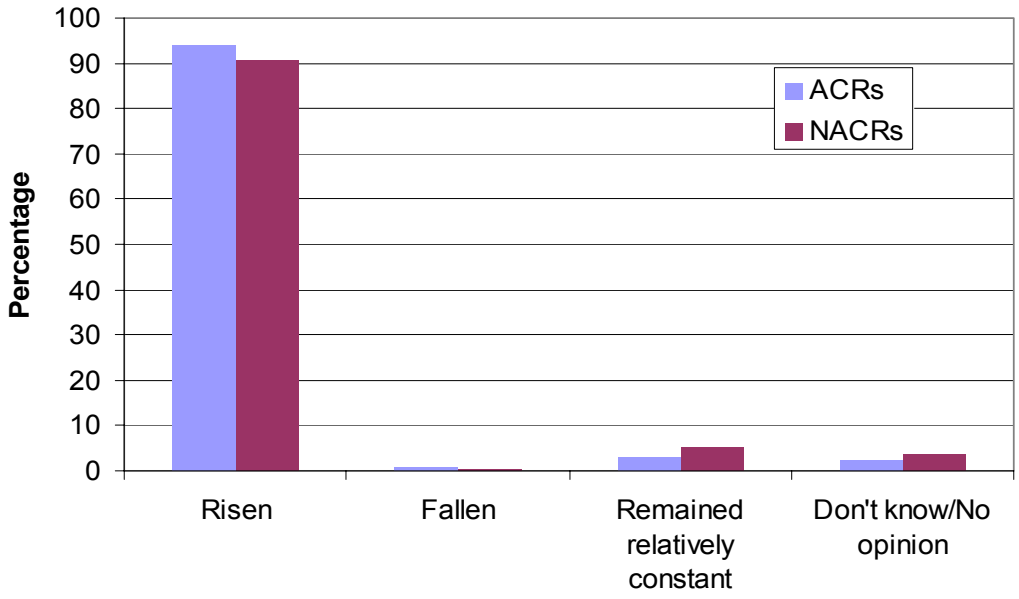

Figure 20. ACR vs. NACR response distribution to Q1, "When compared with pre-1800's levels, do you think temperatures have generally risen, fallen, or remained relatively constant?"

Q2: "Do you think human activity is a significant contributing factor in changing mean global temperatures?" When asked Q2, 82.8% of NACRs thought that human activity was a significant contributing factor (option 1), while 90.4% of ACRs shared that view. 3.5% of ACRs did not think that human activity was a significant contributing factor (option 2), while 5.8% of NACRs agreed. 11.5% of NACRs were unsure of the role of human activity in changing temperatures (option 3), while only 6% of ACRs reported their uncertainty (Figure 21).

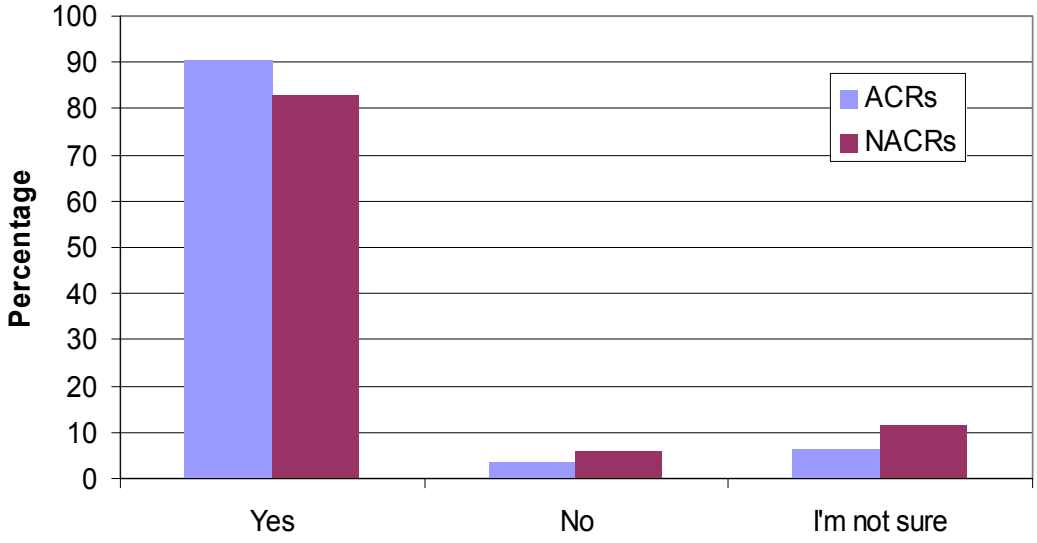

Figure 21. ACR vs. NACR response distribution to Q2, "Do you think human activity is a significant contributing factor in changing mean global temperatures?"

Q3a: If participants responded that they do believe human activity is a significant factor in changing mean global temperatures, they were directed to question 3a, which asked, *"What do you consider to be the most compelling argument that supports your previous answer (that human activity IS a significant factor is changing mean global temperatures)?"* The only very notable difference in the answers provided by the ACR vs. the NACR participants was the percentage of respondents who chose "the results of global climate models (GCMs)" (option 6). Only 2.2% of NACRs chose this option, while 9.8% of ACRs did (Figure 22).

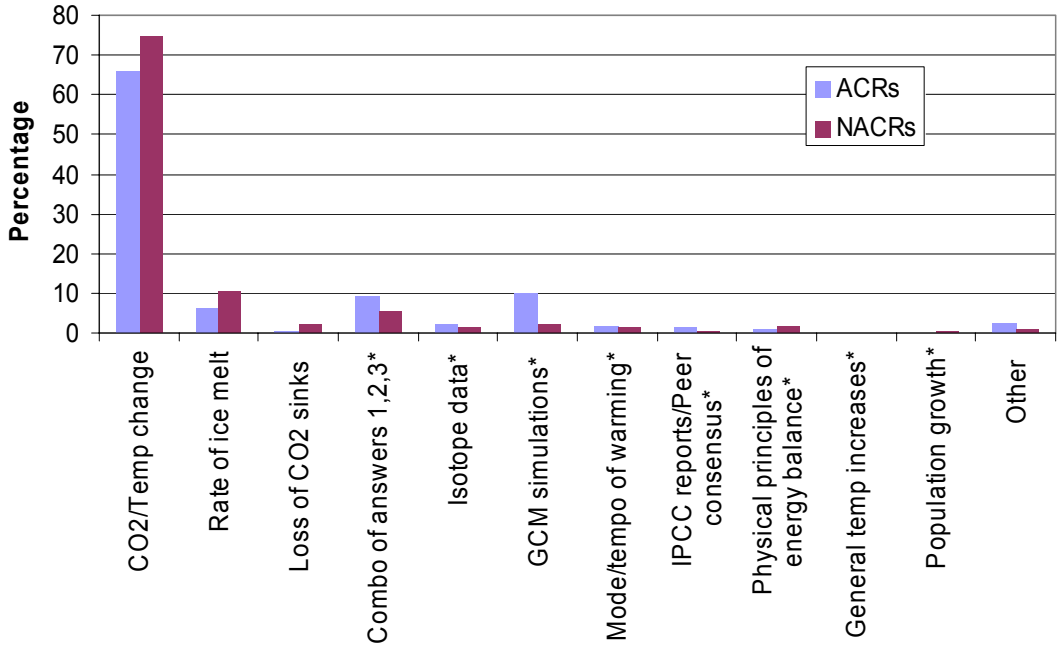

Figure 22. ACR vs. NACR response distribution to Q3a, "What do you consider to be the most compelling argument that supports your previous answers (that human activity IS a significant contributing factor to changing temperatures)?" (Asterisks denote categories created to accommodate write-ins).

Q3b: If participants responded that they do not believe human activity is a significant factor in changing mean global temperatures, they were directed to question 3b, which asked, *"What do you consider to be the most compelling argument that supports your previous answer (that human activity IS NOT a significant factor is changing mean global temperatures)?"* The very small group of ACRs answered that human activity was not a significant contributing factor in changing global temperatures in Q2 (7 participants), which makes it difficult to compare the ACR answers with the NACR answers. Of the small group of ACRs, ~78% chose "natural climate cycles" (option 2), while 55% of the NACRs chose the same answer (Figure 23).

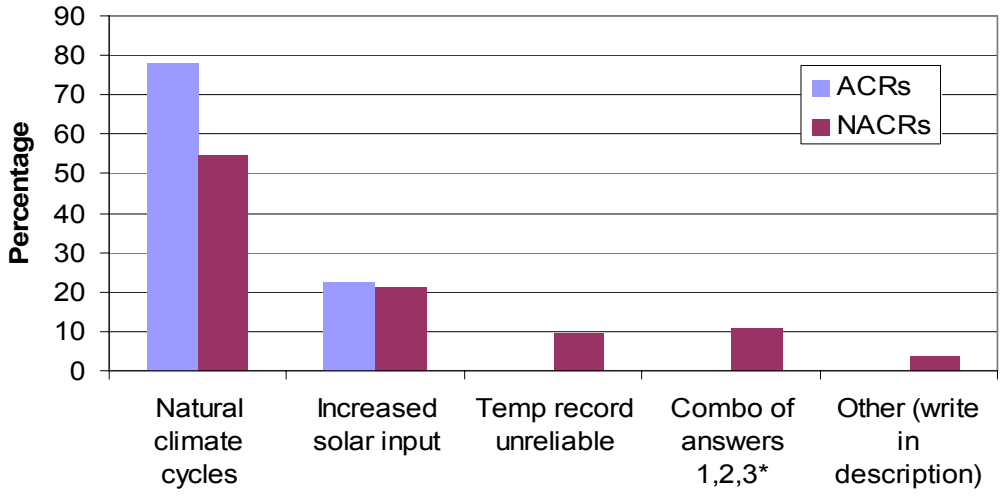

Figure 23. ACR vs. NACR response distribution to Q3b, "What do you consider to be the most compelling argument that supports your previous answer (that human activity is NOT a significant contributing factor to changing global temperatures?)" (Asterisk denotes category created to accommodate write-ins).

Q4: Question four asked participants to, *"Please estimate the percentage of your fellow geoscientists who think human activity is a contributing factor to global climate change."* When asked Q4, the average response of NACRs was 78%, while the average response of ACRs was 85.7%. The response distribution shows that 71% of the NACRs believed 80% of more of their fellow geoscientists think human activity was a contributing factor in changing temperatures, while 86% of ACRs answered the same way (Figure 24).

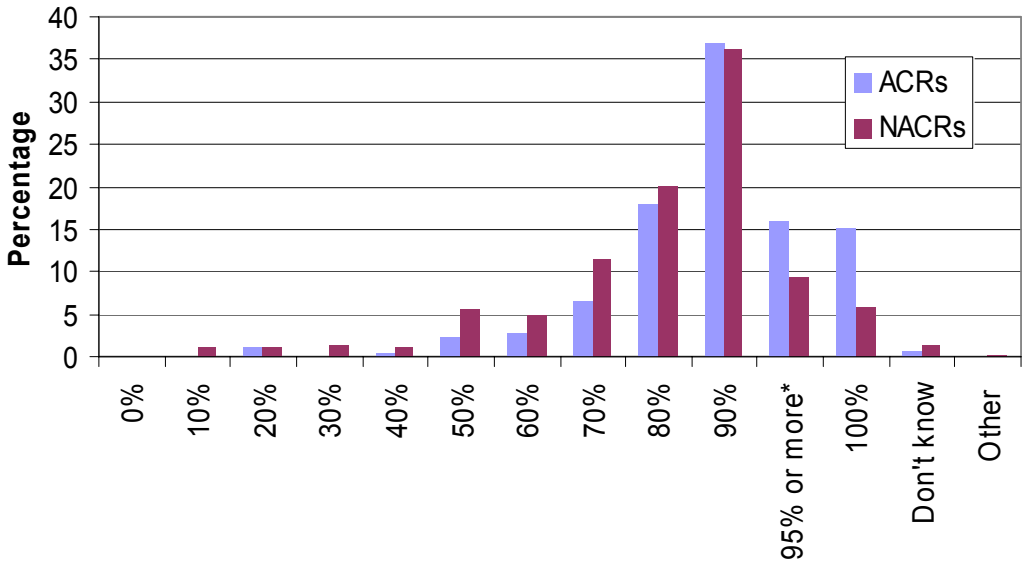

Figure 24. ACR vs. NACR response distribution to Q4, "Please estimate the percentage of your fellow geoscientists who think human activity is a contributing factor to global climate change." (Asterisk denotes category created to accommodate write-ins.)

E. Other Notable Participant Groups

The demographics of the subsequent groups follow generally similar distributions, but their responses to Q1, Q2, and Q4 are worth noting. In some cases, the percent of publishers in the group is noted, along with their status as active climate researchers (answer of 2 in Q5).

1. Economic geologists

Economic geologists accounted for 3.3% of the cumulative survey participant population (n=103). When asked Q1: *"When compared with pre-1800's levels, do you think that mean global temperatures have generally risen, fallen, or remained relatively constant?"* 75.7% of economic geologists responded that mean global temperatures had risen (option 1), while no participant responded that temperatures had fallen (option 2). When asked Q2: *"Do you think human activity is a significant contributing factor in changing mean global temperatures?"* 54.5% of economic geologists said yes (option 1), 20.5% said no (option 2), and 25% said they were unsure (option 3) (Figure 25). When asked Q4: *"Please estimate the percentage of your fellow geoscientists who think human activity is a contributing factor to global climate change."* the average estimate was 61.7%. Only 1% of economic geologists would be considered active climate researchers (more than 50% of their peer reviewed publications in the last five years have been on the subject of climate change).

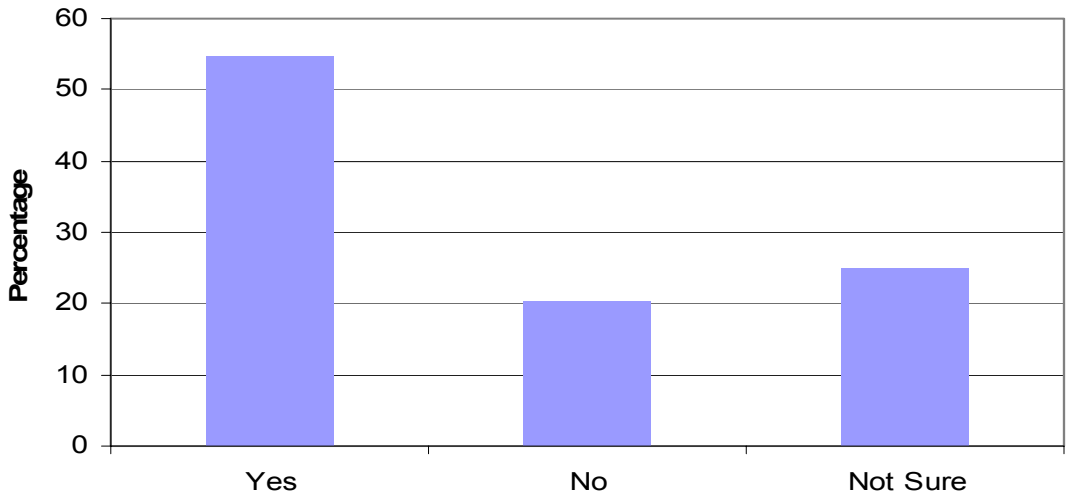

Figure 25. Response distribution of economic geologists to Q2, "Do you think human activity is a significant contributing factor in changing mean global temperatures?"

2. Meteorologists

The group of meteorologists participating in this survey was relatively small (n=36); they accounted for only 1% of the cumulative survey participant population. When asked Q1: *"When compared with pre-1800's levels, do you think that mean global temperatures have generally risen, fallen, or remained relatively constant?"* 97.2% of meteorologists responded that mean global temperatures had risen (option 1), while 2.7% responded that temperatures had fallen (option 2). When asked Q2: *"Do you think human activity is a significant contributing factor in changing mean global temperatures?"* 63.9% of meteorologists said yes (option 1), 11% said no (option 2), and 25% said they were unsure (option 3) (Figure 26). When asked Q4: *"Please estimate the percentage of your fellow geoscientists who think human activity is a contributing factor to global climate change."* the average estimate was 78%. Meteorologists who published made up 53% of the group, and only 2.7% of meteorologists would be considered active climate researchers (more than 50% of their peer reviewed publications in the last five years have been on the subject of climate change).

As meteorologists are later compared with climate scientists, it is important to make explicit the difference between these two groups. The American Meteorological Society defines meteorology as the use of "scientific principles to explain, understand, observe, or forecast the earth's atmospheric phenomena and/or how the atmosphere affects the earth and life on the planet" (American Meteorological Society, www.ametsoc.org). In contrast, climate science is the study of climate, which is defined by the IPCC as average weather, or "the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years" (Solomon, et al., 2007). Thus, while meteorologist study recent weather and weather patterns, climate scientists study these patterns over long periods (typically more than 30 years) of time and attempt to characterize long-term changes.

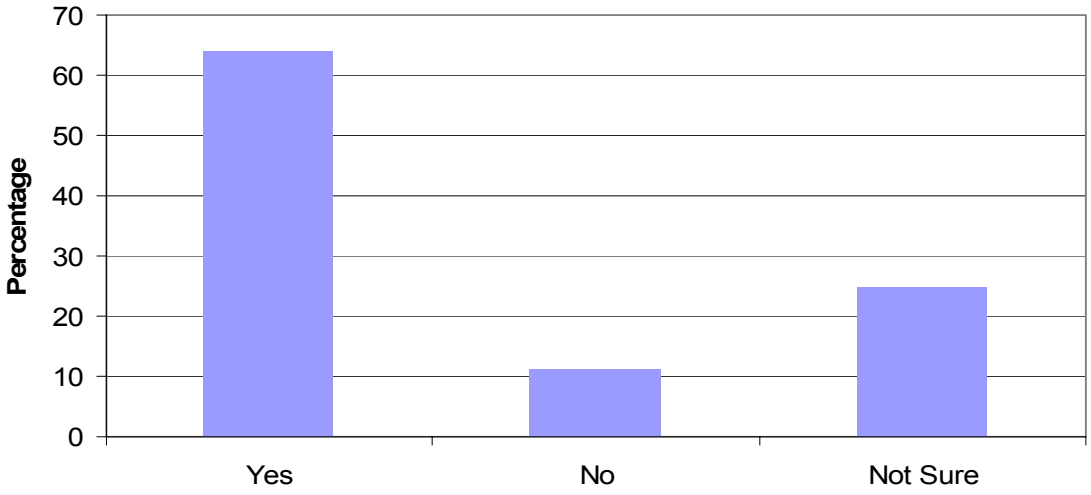

Figure 26. Response distribution of meteorologists to Q2, "Do you think human activity is a significant contributing factor in changing mean global temperatures?"

3. Publishing participants

Publishing participants (n=1749) (those who answered with options 1 or 2 in Q5), account for 55.5% of the cumulative survey participant population. When asked Q1: *"When compared with pre-1800's levels, do you think that mean global temperatures have generally risen, fallen, or remained relatively constant?"* 93% of publishing geoscientists responded that mean global temperatures had risen (option 1), while 0.5% responded that temperatures had fallen (option 2), 4% believed temperatures had remained relatively constant (option 3), and 2.5% responded that they did not know, or had no opinion (option 4). When asked Q2: *"Do you think human activity is a significant contributing factor in changing mean global temperatures?"* 88.6% of publishing geoscientist said yes (option 1), 3.5% said no (option 2), and 8% said they were unsure (option 3) (Figure 27). When asked Q4: *"Please estimate the percentage of your fellow geoscientists who think human activity is a contributing factor to global climate change."* the average estimate was 83.7%.

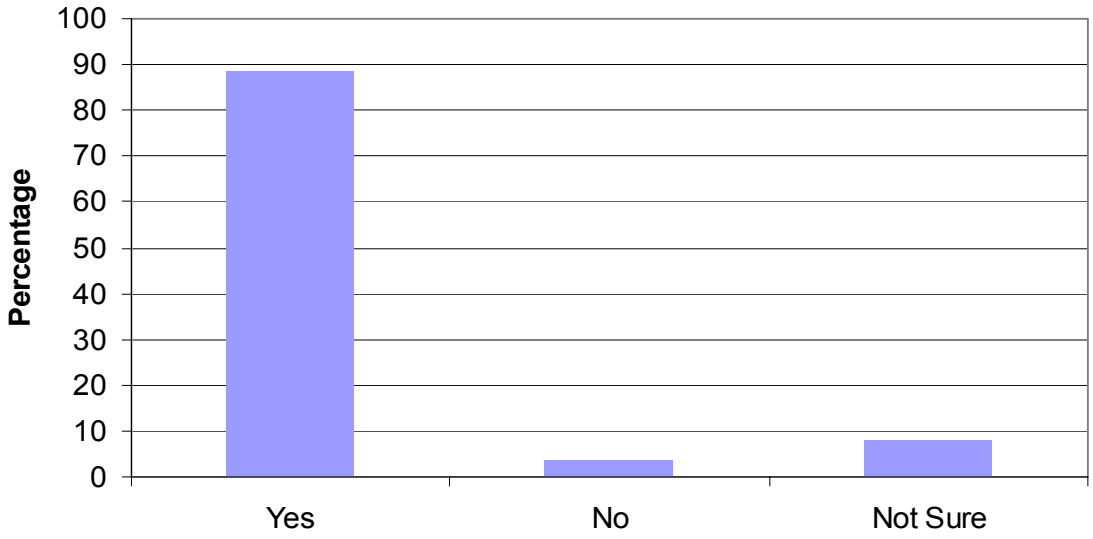

Figure 27. Response distribution of active publishers (those who publish more or less than 50% of their peer-reviewed publications in the last five years on the subject of climate change) to Q2, "Do you think human activity is a significant contributing factor in changing mean global temperatures?"

3. Climate Scientists

Climate scientists (n=144) (those who answered with option 10 when asked their area of expertise), account for only 4.5% of the cumulative survey participant population. When asked Q1: *"When compared with pre-1800's levels, do you think that mean global temperatures have generally risen, fallen, or remained relatively constant?"* 95% of climate scientists responded that mean global temperatures had risen (option 1), while 0.7% responded that temperatures had fallen (option 2), 2.7% believed temperatures had remained relatively constant (option 3), and 1.3% responded that they did not know, or had no opinion (option 4). When asked Q2: *"Do you think human activity is a significant contributing factor in changing mean global temperatures?"* 88.6% of climate scientists said yes (option 1), 5.7% said no (option 2), and 5.7% said they were unsure (option 3) (Figure 28). When asked Q4: *"Please estimate the percentage of your fellow geoscientists who think human activity is a contributing factor to global climate change."* the average estimate was 84%. 91% of climate scientists have published, and 54.9% of them are considered active climate researchers (ACRs) based on their publication history.

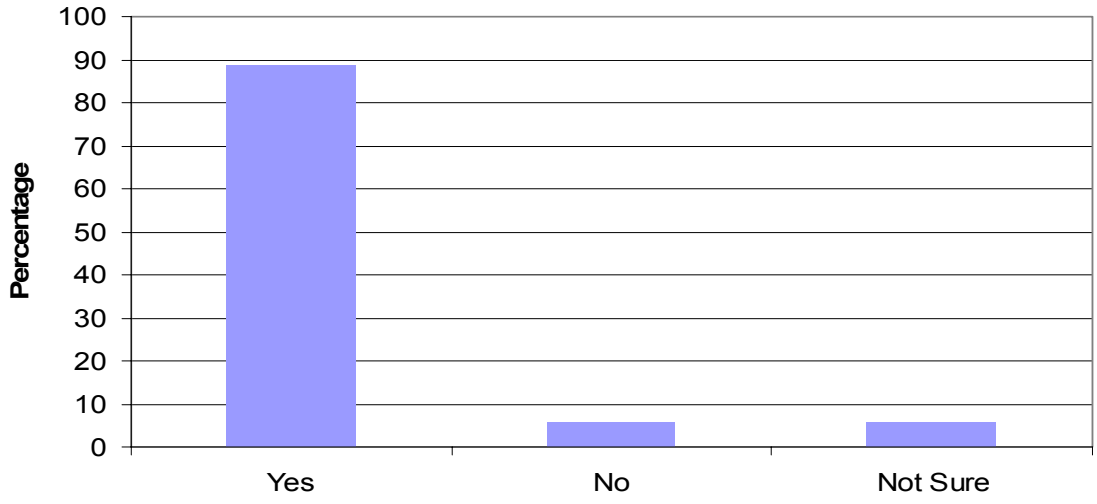

Figure 28. Response distribution of climate scientists to Q2, "Do you think human activity is a significant contributing factor in changing mean global temperatures?"

4. Active Climate Researchers with Climate Science expertise

Climate scientists who have also published more than 50% of the peer-reviewed papers in the last five years on the subject of climate change constitute a highly specialized expert group, active climate researcher (ACR) climatologists (n=79). This group makes up only 2.5% of the respondents. When asked Q1: *"When compared with pre-1800's levels, do you think that mean global temperatures have generally risen, fallen, or remained relatively constant?"* 96.2% of ACR climatologists responded that mean global temperatures had risen (option 1), while 1.2% responded that temperatures had fallen (option 2), and 2.5% believed temperatures had remained relatively constant (option 3). When asked Q2: *"Do you think human activity is a significant contributing factor in changing mean global temperatures?"* 97.4% of ACR climatologists said yes (option 1), 1.3% said no (option 2), and 1.3% said they were unsure (option 3) (Figure 29). When asked Q4: *"Please estimate the percentage of your fellow geoscientists who think human activity is a contributing factor to global climate change."* the average estimate was 90%.

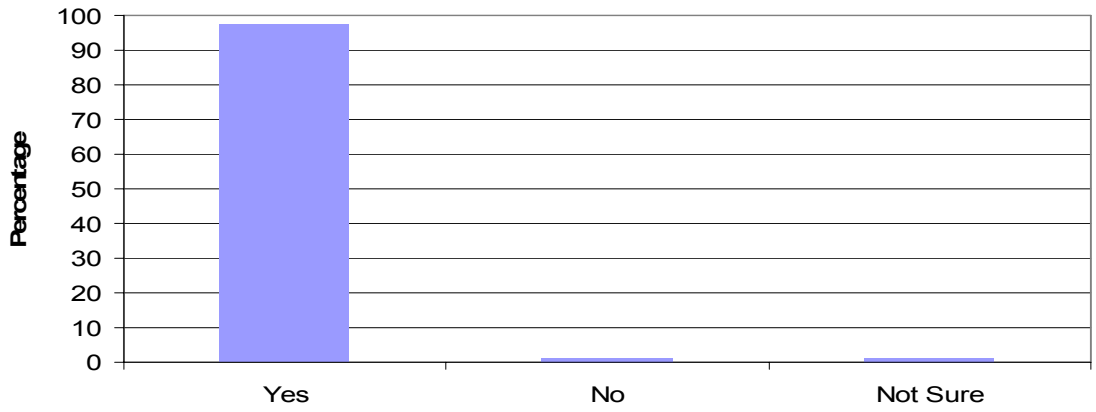

Figure 29. Response distribution of ACR climatologists to Q2, "Do you think human activity is a significant contributing factor in changing mean global temperatures?"

F. Answer Dependant Consensus Perception

Participants own opinions on current temperature changes and the roles of human activity in global climate change appear to influence their perception of a consensus among their peers on the roles of human activity as a contributing factor to global climate change.

1. Consensus estimate based on answer to Q1

Those who said that temperatures had risen (option 1) when asked Q1: *"When compared with pre-1800's levels, do you think that mean global temperatures have generally risen, fallen, or remained relatively constant?"* estimated an average of 80.5% of their fellow geoscientists thought human activity is a contributing factor to global climate change (Figure 30). Those who responded that temperatures had fallen (option 2) when asked Q1 estimated on average 82% of their fellow geoscientists thought human activity is a contributing factor to global climate change. Those who, when asked Q1, responded that temperatures had remained relatively constant (option 3) estimated that, on average, 60.3% of their fellow geoscientists thought human activity is a contributing factor to global climate change. Finally, those who they were unsure whether temperatures had risen, fallen, or remained relatively constant or who had no opinion on the question (option 4) estimated that, on average, 63% of their fellow geoscientists thought human activity is a contributing factor to global climate change.

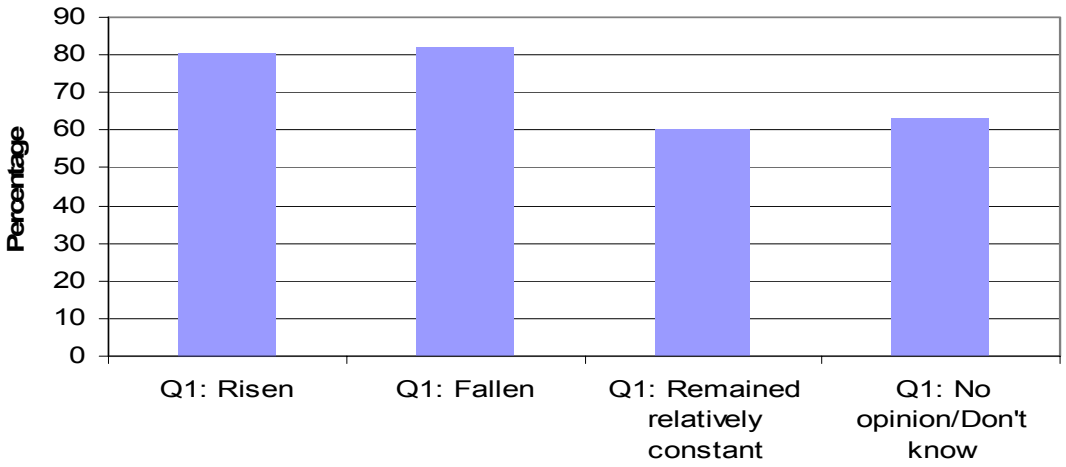

Figure 30. Average estimate of percept of geoscientists who think that human activity is a significant contributing factor to global climate change sorted by participant response to Q1, "When compared with pre-1800's levels, do you think that mean global temperatures have generally risen, fallen, or remained relatively constant?"

2. Consensus estimate based on answer to Q2

Those who said responded yes (option 1) when asked Q2: *"Do you think human activity is a significant contributing factor in changing mean global temperatures?"* estimated on average that 84.4% of their fellow geoscientists thought human activity is a contributing factor to global climate change (Figure 31). Those who responded no (option 2) to Q2 estimated that, on average, 45.6% of their fellow geoscientists thought human activity is a contributing factor to global climate change. Those who, when asked Q2, responded that they were unsure (option 3) estimated that, on average, 62% of their fellow geoscientists thought human activity is a contributing factor to global climate change.

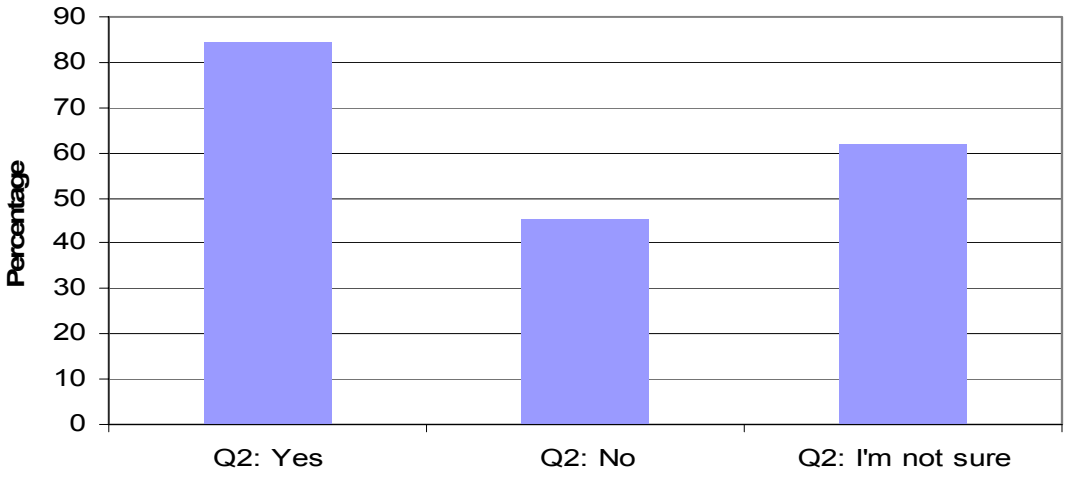

Figure 31. Average estimate of percept of geoscientists who think that human activity is a significant contributing factor to global climate change sorted by participant response to Q2, "Do you think human activity is a significant contributing factor in changing mean global temperatures?"

IV. DISCUSSION

A. Emails

It is important to make note of the vast number of emails that I received from survey participants as the emails often shed light on how participants were interpreting the survey itself, along with their reactions. In total, I received over 500 emails from potential and actual survey participants (pertinent emails can be found in Appendix G). Emails fell into several main categories; declines of participation, requests for aggregate data, critiques, well wishes, declarations, thoughts and musings, and general comments. Many emails were simply confirmations that they had completed the survey, but many also contained meaningful text.

Declinations of participation usually contained a reason, most often that they didn't feel qualified to take the survey because they didn't have enough background on climate research, or because their position in their departments was in administration, IT support, or some other non-geoscience field. Some declined because they did not, as a rule, participate in surveys, and still others declined because they believed surveys are not a useful tool, or are an inappropriate way to characterize opinions on a complex issue.

As part of the initial email sent out to potential participants, the offer was made to eventually provide aggregate survey data to participants upon request. This is typical protocol when working with human subjects. About 75 participants requested data is sent to them.

Many participants shared their critiques of the survey. One of the more common complaints was that the issue of climate change was very complex and not adequately addressed by a short simple survey. Critiques of questions or wording were largely centered on question 1 which asked, "When compared with pre-1800's levels, do you think that mean global temperature have generally risen, fallen, or remain relatively constant?" Some participants responded that the question did not provide a specific enough time frame, and could be interpreted to include only temperatures just before 1800 or all temperature changes over millions and millions of years. A few participants

criticized the wording on question 5 which asked, "Which percentage of your papers published in peer-reviewed journals in the last five years have been on the subject of climate change?" They commented that if someone had no publications on climate change, they could have selected either option 1 (<50%) or option 3 (N/A).

Emails containing well wishes or praise for the survey's purpose were appreciated and not as rare as anticipated. Some participants wrote that they thought the survey was well executed and liked the format on QuestionPro, while some others thought the survey was timely and a good idea for assessing attitudes in the scientific community. Many expressed their pleasure at being able to participate in the survey.

Many participants sent emails not to criticize or praise the survey, but simply to share their own beliefs, their reactions to the survey, or muse on the complexity of the climate change issue. Quite a few participants said that the politicizing of the global warming issue was detrimental to the research surrounding climate change and made objective research difficult to obtain. Scores of participants voiced the opinion that, whether or not human activity is a significant driving factor in climate change, policy makers should err to the side of caution and they support measures to reduce greenhouse gas emissions.

Some participants shared general comments in their emails. Their comments ranged from the effectiveness of different types of climate models, to the role of population growth in climate change. Some commented on the current political climate and the role that has played in shaping the nation's attitude on climate change. Still others said they would like to look at the data on climate patterns more closely, so as to develop first-hand opinions on the issue.

B. Perception of Consensus

When looking at participants' estimate of the percentage of their fellow geoscientists who think human activity is a contributing factor to global climate change, the perception of a consensus

– or at very least, general agreement – appears to be dictated by their own opinions on global climate change. In responding to Q1 which asked, *"When compared with pre-1800's levels, do you think that mean global temperatures have generally risen, fallen, or remained relatively constant?"* those who answered that temperatures had risen or fallen perceived a strong average consensus (~80%) among their fellow geoscientists. Yet those believed that temperature had remained the same perceived a lesser average consensus of only 60%, and those who were unsure of their opinion, or had no opinion perceived average consensus of 63%. This suggests that those who maintain a definite opinion on changing temperatures believe more geoscientists think human activity is a contributing factor in global climate change, while those whose opinions are more neutral or who are unsure or do not have an opinion perceive less consensus among geoscientists on the role of human activity.

In response to Q2: *"Do you think human activity is a significant contributing factor in changing mean global temperatures?"* those who answer "yes" perceived a high average consensus among geoscientists (84.4%), but those who answered "no" perceived only half as much agreement (45.6%) among geoscientists that human activity is a significant contributing factor in global climate change. Those we answered Q2 by saying they were unsure perceived 62% consensus. This suggests that, while those who think human activity is a contributing factor in global climate change also believe many of their peers believe the same thing; those who do NOT think human activity is a significant contributing factor in global climate change perceive similar opinions among their fellow geoscientists.

C. The Role of Expertise

As the level of familiarity with the science of climate change increases, so does agreement in the community on the authenticity of global warming (Q1), the role of human activity (Q2), and the perception of consensus among geoscientists (Q4). As mentioned in the introduction, a 2007 Newsweek survey showed that only 52% of Americans believed there was consensus among the

scientific population on the subject of climate change. In March of 2008, another poll, this time done by Gallup, asked U.S. participants a question very similar to the Q2 asked by this study (Gallup, 2008). Their question asked, "…do you believe increases in the Earth's temperature over the last century are due more to the effects of pollution from human activities (analogous to our answer "yes") or natural changes in the environment that are not due to human activities (analogous to our answer "no"). 58% of the Gallup poll participants believed that increases in Earth's temperature were more due to human activity, while 38% believed temperature increases were NOT due to human activity. 5% had no opinion (analogous to our answer of "not sure").

Results from *our* survey data show that, among the general survey participant population of geoscientists (n=3146), there is 90% agreement that temperatures have risen since 1800, and an 82% agreement that human activity is a significant contributing factor. Geoscientists surveyed perceived that, on average, 80% of their fellow geoscientists believed human activity was a factor in changing global temperatures. This most basic survey data shows that, among the geoscientists surveyed, there are indeed high levels of consensus on the authenticity of global warming, the role of human activity, and the perception of consensus among geoscientists.

It is interesting to note that responses among meteorologists often varied greatly from responses by other specialty groups. Of the meteorologists (n=36), who often deal with short-term climate phenomena, 97.2% think that temperatures have risen since 1800, but only 63.7% attribute that change to human activity. While climate research is often a large part of a meteorologist's work, we find a very small percentage of them to be active publishers in the field of climate change. Only 2.7% of meteorologists publish more than 50% of the peer-reviewed research on the subject to climate change, so from this data, we conclude that there are few active *climate* researchers in the meteorology field.

In the community of participants who identified climate science as their specific expertise within the geosciences (n=144), 95% of respondents thought that temperatures had risen since 1800, and 88.6% attributed that rise to human activity. Climate scientists in the survey participant

population perceived that, on average, 84% of their fellow geoscientists believed human activity was a factor in changing global temperatures. Those who identified their expertise as climate change are likely to be familiar with the mechanisms that drive global warming, and have a thorough understanding the current research surrounding the subject.

Focusing on expertise further, we can look at the responses from the group of geoscientists who publish more than 50% of their recent peer-reviewed papers on the subject of climate change, our active climate researchers (ACRs) (n = 244). 95% of ACRs thought that temperatures had risen during the past ~200 years, and 92% thought human activity was a significant contributing factor. On average, this group perceived an 87.2% consensus among their fellow geoscientists that human activity was a contributing factor to global warming. Participants who publish more than 50% of their recent peer-reviewed papers on the subject of climate change can have varying areas of expertise, but are likely very familiar with the current research on climate change, and are active contributors to that body of work.

Finally, our "experts." or ACR climatologists, those who both list climate science as their area of expertise AND have published more than 50% of their recent peer-reviewed papers on the subject of climate change (n = 79), show the highest level of consensus on Q1, Q2, and Q4. 96.2% of ACR climatologists thought that current temperatures have risen when compared with pre 1800's temperatures, and 97.4% thought human activity was a significant contributing factor to that rise. On average, this group perceived a 90% consensus among their fellow geoscientists that human activity was a contributing factor to global warming. The participants in this group are actively publishing climate scientists, and those most likely to be familiar with the theory and mechanisms of climate change, as well as have a thorough understanding of the current research and be actively contributing to the field.

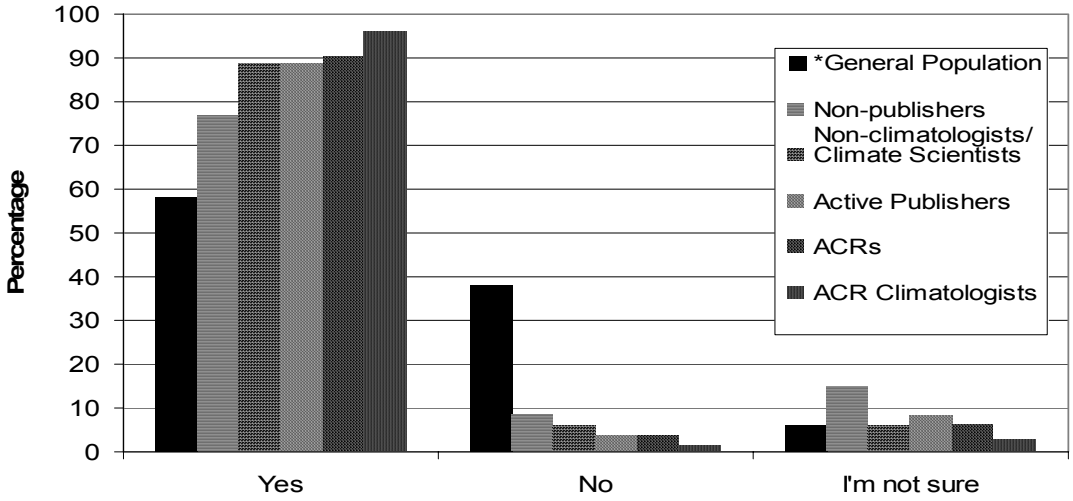

Figure 32. Comparative response distribution to Q2, "Do you think human activity is a significant contributing factor in changing mean global temperatures?" from U.S. general population (Gallup, 2008), non-publishing and non-climate scientists, climate scientists, active publishers, ACRs, and ACR climatologists. *Gallup poll asked, "…do you believe increases in the Earth's temperature over the last century are due more to 1) the effects of pollution from human activities (yes), 2) natural changes in the environment that are not due to human activities (no), or 3) no opinion (not sure).

A side-by-side comparison of these increasingly specialized levels of expertise highlights a definite trend in Q2 (Figure 32). Figure 32 compares responses to the similar question from the March 2008 Gallup poll of U.S. residents and the responses to Q2 given by those who do not publish, and are not climate scientists (essentially, those participants who are not already accounted for in the following categories), to those from climate scientists, active publishers, ACRs, and ACR climatologists. As expertise in the area of climate change increases so does the propensity to think that human activity is a significant driving factor in increasing temperatures over the last ~200 years.

Across all demographics, the vast majority of those who thought human activity was a significant driving factor in changing temperatures thought that the most compelling argument for the role of human activity was the coupled changed in atmospheric CO_2 and the rise in temperatures. This trend generally became more pronounced as expertise increased.

V. CONCLUSIONS

Recent polls (Princeton Survey Research Associates International, Aug. 1-2, 2007) have shown that only 52% of Americans think most climate scientists agree that the earth has been warming in recent years, and only 47% think climate scientists agree that human activities are a major cause of that warming. This study has shown that there is substantially more consensus on the topic of global warming among earth scientists, and, in particular climate scientists, than is perceived by the general population in the U.S.

To our first question, *Q1: "When compared with pre-1800's levels, do you think that mean global temperatures have generally risen, fallen, or remained relatively constant?"* 89.5% of survey participants thought temperatures had risen, while 0.5% thought temperatures had fallen, 5.7% thought it had remained relatively constant, and 4.2% had no opinion or were unsure. To our second question, *Q2: "Do you think human activity is a significant contributing factor in changing mean global temperatures?"* 82% of survey participants said yes, while 6.7% said no, and 11% said they were not sure. When our survey participants were asked in Q4, *"Please estimate the percentage of your fellow geoscientists who think human activity is a contributing factor to global climate change"* the average estimate was 80%, i.e. about 30% more than the general U.S. population. Yet individual estimates appear to be strongly tied to participants own opinions, where those who believe human activity is a significant contributing factor in global climate change also perceive a high consensus among their peers on the same issue, and those who do not believe that human activity is a significant contributing factor perceive a much lower consensus among fellow geoscientists.

The vast majority of participants cite the coupled change in atmospheric CO_2 and average global temperatures as the most compelling argument for the role of human activity in changing global temperatures. Those who thought human activity was NOT a significant contributing factor to changing global temperatures most often attributed apparent temperature changes to natural climate cycles.

As the survey population is partitioned into specialized groups with an increasing expertise in the area of climate change, the percentage of participants who think that temperatures have risen and that human activity is a significant driving factor increases.

We see the percent of participants responding that, yes, human activity is a significant contributing factor in changing temperatures, go from 77 % in the group of participants who do not publish and do not list their expertise as climate science, to 88 % among climate scientists and active publishers, to 92 % among those who publish more than 50 % of their recent peer-reviewed papers on the subject of climate science, all the way to 97.4 % among those participants who list their area of expertise as climate science AND who publish more than 50% of their recent peer-reviewed papers on the subject of climate science. When these numbers are compared with the 2008 Gallup poll that found only 58% of Americans think that human activities are a major factor in increasing temperatures, the take home message from these data seems to be that the more of an authority you are on the subject of climate change and the more active you are in climate change research, the more you are likely to believe that humans are a significant factor in recent climate change. Interestingly, among our survey participants the perception of a consensus on climate change issues in their own professional communities also increases with expertise in the area of climate change.

It seems that the debate, whatever its origins, on the authenticity of global warming and the role played by human activity is largely nonexistent among those who are most able to understand the nuances and scientific basis of the issue. The challenge now is to find a way to effectively communicate this to the general population and attempt to silence media sources which continue to purport a defunct claim of wide spread disagreement among earth scientists.

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APPENDICES

Survey

Q#	QUESTION / PROMPT	CODE	ANSWER OPTIONS	BRANCH
Q1	**When compared with pre-1800's levels, do you think that mean global temperatures have generally risen, fallen, or remained relatively constant?**	**1**	Risen	Q2
		2	Fallen	Q2
		3	Remained relatively constant	Q4
		4	No opinion/Don't know	Q2
Q2	**Do you think human activity is a significant contributing factor in changing mean global temperatures?**	**1**	Yes	Q3a
		2	No	Q3b
		3	I'm not sure	Q3c
Q3a	**What do you consider to be the most compelling argument that supports your previous answer?**	**1**	Coupled change in atmospheric CO_2 and average global temperatures	Q4
		2	Rate of glacial/sea ice melt	Q4
		3	Loss of CO_2 sinks (e.g. deforestation)	Q4
		4	All or combination of above factors*	Q4
		5	CO2 and Carbon isotope data from rocks, ice coree/man-made signal in carbon isotopes*	Q4
		6	GCM simulations*	Q4
		7	Rate/Magnitude of warming compared with natural rate*	Q4
		8	IPCC reports/Peer consensus*	
		9	Physical pricinpals of energy balance*	
		10	General temperature increases*	Q4
		11	Population growth and corresponding demand and	Q4

			production of CO2*	
		12	Other (write in description)	Q4
Q3b	**What do you consider to be the most compelling argument that supports your previous answer?**	**1**	Natural climate cycles (e.g. Milankovitch cycles)	Q4
		2	Increased solar input in recent years (e.g. solar flares)	Q4
		3	Current or reconstructed temperature record is unreliable	Q4
		4	All or a combination of the above factors*	Q4
		5	Other (write in description)	Q4
Q3c	**What makes you unsure if human activity is a significant contributing factor in changing global mean temperatures?**	**1**	Please explain (write in description)	Q4
Q4	**Please estimate the percentage of your fellow geoscientists who think human activity is a contributing factor to global climate change.**	**1**	0%	Q5
		2	10%	Q5
		3	20%	Q5
		4	30%	Q5
		5	40%	Q5
		6	50%	Q5
		7	60%	Q5
		8	70%	Q5
		9	80%	Q5
		10	90%	Q5
		11	95% or more*	Q5
		12	100%	Q5
		13	Don't know	Q5
		14	Other (write in number)	Q5

Q5	**Which percentage of your papers published in peer-reviewed journals in the last 5 years have been on the subject of climate change?**	**1**	Less than 50%	Q6
		2	50% or more	Q6
		3	Not Applicable	Q6
Q6	**Age**	**1**	<25	Q7
		2	25-35	Q7
		3	36-45	Q7
		4	46-55	Q7
		5	56-65	Q7
		6	66-75	Q7
		7	>75	Q7
		8	I prefer not to answer	Q7
Q7	**Please indicate your gender**	**1**	Male	Q8
		2	Female	Q8
		3	I prefer not to answer	Q8
Q8	**What is the highest level of education you have attained?**	**1**	High School or equivalent	Q9
		2	Some college	Q9
		3	Associates degree	Q9
		4	B.A. or B.S	Q9
		5	Some graduate school	Q9
		6	M.A. or M.S.	Q9
		7	M.B.A	Q9
		8	Ph.D.	Q9
		9	M.D.	Q9
		10	Other (write in description)	Q9
Q9	**Which category best describes your area of expertise?**	**1**	Hydrology/Hydrogeology	END
		2	Geochemistry	END
		3	Geophysics	END
		4	Paleontology	END
		5	Economic Geology (coal/metals/oil and gas)	END

		6	Soil Science	END
		7	Oceanography/Marine Geology	END
		8	Environmental Geology	END
		9	Planetary Geology/Planetary Science	END
		10	Climate Science	END
		11	Geomorphology	END
		12	General Geology	END
		13	Structure/Tectonics*	END
		14	Petrology*	END
		15	Sedimentology/Stratigraphy *	END
		16	Atmospheric Science*	END
		17	Quaternary Geology*	END
		18	Meterology*	END
		19	Geography/Archeaology/GIS*	END
		20	Engineering (Envr/Geo/Chem)*	END
		21	Ecology/Biogeochemistry*	END
		22	Glacial Geology*	END
		23	Mineralogy*	END
		24	Volcanology*	END
		25	Other (write in description)	END

Email Invitations 1 and 2

Dear [Participant],

I am writing to ask you to participate in a research study that I am conducting as part of my Master's thesis at the University of Illinois at Chicago. The purpose of this study is to collect information on the opinions and attitudes of geoscientists regarding global climate change and the existence of a scientific consensus on the issue.

CLICK HERE TO PARTICIPATE IN A SHORT (2 MINUTE) SURVEY

This study consists of an online survey that will be administered to individual participants using a secure survey site. You will be asked to provide answers to two to four questions on global climate change, and to provide basic demographic information.
Your participation is entirely voluntary. You may stop taking the survey at any time without consequence. Should you decide to participate in this study, you may access the survey by following the web link located at the end of this email. Individual responses will be temporarily linked to your email address in an effort to ensure that only invited participants complete the survey, and that each respondent participates only once. Once the window for survey responses closes, all names will be dissociated from responses identification numbers, ensuring that your answer will remain confidential. Final aggregate results of this study will be made available to participants upon request.

By completing the survey link, you are consenting to participate in this research survey.

CLICK HERE TO PARTICIPATE IN A SHORT (2 MINUTE) SURVEY

If you have any questions about this study, please contact me at any time.

Thank you for taking the time to participate.

Sincerely,
Maggie Zimmerman

==========

Maggie Kendall Zimmerman
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Email Invitations 3

Dear [Participant],

Many of you have said that you would like to participate in this survey, but haven't had the time yet. If you would still like to participate in this survey, I wanted to let you know that the survey will close on Thursday, 4/17/08, at noon, so please submit your responses before that time.

If you have already submitted your response, I thank you again for your participation!

As always, I'm happy to answer any questions you may have.

Many thanks,
Maggie Zimmerman

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COPY OF EMAIL INVITATION 1

==========

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Write-ins to Question 3a

Hind cast models of tropospheric temperature that include anthropogenic radiative forcing better match observed temperature than models that only use natural variations in radiative forcing.
Coupled change of CO2 and temperature observed and predicted by sophisticated climate models
State-of-the-art models are unable to produce temperature changes as large as those observed without including the effect of rising greenhouse gas concentrations
CO2 increase + radiative balance modelling
measured increased in CO2 much higher than what is present due to natural biogenic processes
It is too complex to fit in this tiny box. The logical thought train includes many kinds of data and observations, can't be reduced to a sound bite.
ice cores, polar icecap melts, glacial melts, CO2 change in atmosphere coupled with avg global temps, migration by plant and animal species to previously uninhabited areas for those species
the 3 mentioned plus changes in species behavior and territories plus the warmeing of the ocean and sea level rise
It is the combination of increased desertification, CO2, increase, increase rate of glacial retreat, rise of sea level.
early anthropogenic hypothesis
All evidence combined
The combination of the three choices, plus climate models.
model separation of natural and anthropogenic components
Modeling shows that current warming cannot be explained without including a human-caused input of CO2
decreasing pH of the oceans
Both loss of CO2 sink (deforestation) and increase CO2 production by industrialized countries
coupled rise in CO2 and industrialization
Physics requires that CO2 MUST have a greenhouse effect - hence 'contributing'. Dominating? Don't know yet, but I don't want to find out the hard way.
Combination of observations and arguments.
Attribution studies cited in FAR of IPCC
The combination of facts and models, especially including the recent accelerated rate of temperature rise that couples with a recent accelerated rate of CO2 rise and all agreeing with expectations based on known scientific principals, such as the 'greenhouse' effect itself (greenhouses are indeed warm in winter)
vast prepondorance of many lines of evidence
Loss of Quaternary permafrost
expectations from physics
Match between models and observations
Increase in energy production
All listed
All of the factors noted, together provide compelling evidence for the reality of anthropogenic global rise in temperatures
rate at which atmos CO2 is rising, and rate of ave temp change.
rate of consumption relative to rate of carbon burial
It's more than just a correlation between rising CO2 and higher temperaures. It's the physics that we understand that underlies that correlation.
Distinct increase in CO2 levels after the onset of the industrial revolution
Understanding of basic physical theory of climate
CO2 increase + isotopic evidence that atmospheric carbon now has a fossil fuel signature
both 2 and 3

IPCC models showing fit to historical warming only if (anthropogenic) CO2 included in model
change in the isotopic signature of carbon in the atmosphere
That CO2 is the only known forcing going in the same direction as temperature change in the last 50 years
energy balance calculations
combination of observations
The qualitative and quantitative agreement between the listied indications and many others.
Models require anthropogenic component to reproduce current temperature rise
the rise in CO2 in the atmosphere coupled with increases in global temperature and the observation that human burn large amounts of fossil fuels
increase in anthropomorphically generated CO2 b/c of industrial activity; global maps of greenhouse gas release associated with industrialized nations
steepness of rise and record high of CO2
All of the things listed, and others, contribute
A collective body of scientific data that includes the options given and many more options that are not included as possible answers to this question
It's all of these, plus more: there is an overwhelming combination of evidence from many different aspects.
The observed heat storage of the ocean cannot be simulated by any reasonable model without invoking human-induced greenhouse forcing.
Results from GCM's (Global Circulation Models)
climate records show that temperatures have increased: analytical data shows that CO2 concentrations have increased; theoretical and experimental data show that increased CO2 creates a greenhouse effect that causes global warming; combustion of biomass and fossil fuels creates CO2. this answer might look like once of your choices [coupled change in atmospheric...], but I want to make the point that while i believe there is a relationship between CO2 and global temperature, i have not seen data that clearly show that increased CO2 concentrations in the atmosphere actually preceeded increased temperatures.
all the above plus population growth
rate of fossil fuel CO2 input, deforestation, changes in global temperatures, results from GCMs, evidence of recent climate change (temperatures, sea ice, glaciers, etc.)
pattern of changes is consistent with what is expected for CO2 and other anthropogenic forcings
The second answer plus the Antarctic ice core data that show current CO2 levels higher and faster over that rise than at any time in the past 600,000 years.
All of these are indicators, but there are also others such as rises in atmospheric methane levels and comparisons to pre-Anthropogenic levels. I teach this stuff, so it would be a complete lecture to give you all the reasons
successful modeling of T trends
sea level rise, glacier/ice sheet/sea ice melt, observed global temperature rise, reduce of snow fall in the N. Hemisphere, increase of CO2 and other greenhouse concentrations and temperature increase
I consider all three of the options given compelling; I don't think any one of them is more compelling than another.
The overall combination of factors and changes
ice core record of CO2, carbon isotope data for atmosphere
ice core record of temperature
Simple physics. Pre-anthroponeic influence, greenhouse gases boost mean global temperatures ~55 degrees Fahrenhiet. Adding to the greenhouse gas blanket can only make that number greater.
models of natural variations cannot account for temperature rise
relationship between population increase/fossil fuel use and mean sea sureface temperature increase
all listed factors (i.e., summ of evidence)
All these factors
Multiple : rising sea level; polar ice shrinkage, science of CO2 as a greenhouse gas, rate of rising global temps, etc
coupled change (your selection # 2, combined with geologic record of climate change

the associated rise in greenhouse gas concentrations in the atmosphere
Scientific reasoning combined with observations of temperature change
increased burning of fossil fuels since the industrial revolution
All those pages of all those IPCC reports
the observed pattern of climate changes (horizontal and vertical variation) is consistent with human-induced change and not consistent with other sources of change such as solar variability or soley land-use changes
It seems to me that land use changes have clearly contributed, although it is not obvious to me that the main influence of deforestation, for example, is necessarily related to CO2 sources/sinks. Some of the warming may also have been unrelated to human activities
both 1 and 2
Combination of our understanding of the physics of climate as integrated into climate models, and the ability of these models to hindcast the past 150 years of climate (co2 and temperature) only when including anthropogenic enhancement of the atmospheric greenhouse gas burden contributed by humans.
All of the above
all above
modeling and flux determination of global carbon budget
coupled CO2 rise with fossil C comsumption
The only known forcing mechanism sufficient to account for the observed increase in global mean surface temperature is radiative forcing associated with increases in greenhouse gases in the atmosphere, most prominently carbon dioxide, together with aerosols (particularly soot), amplified by known net positive feedbacks (such as water vapor feedback and ice-albedo feedback in the polar regions). The primary tool for demonstrating the impact of hypothesized forcing mechanisms are global climate models. Strong observational evidence indicates that the primary sources of additional greenhouse gasses and soot are anthropogenic. No one has been able to demonstrate in any convincing way that alternative, non-anthropogenic forcing mechanisms can account for the observations of global warming.
Modeling shown in the IPCC report that shows that natural factors alone cannot explain the T increase. A mixture of natural factors and anthropogenic CO2 are need to reproduced the temperature trends
The human production of greenhouse gasses in concert (synchroneity) with the changes listed to the left
All of the above.
The linke between CO2 rise and temperature change is most convincingly made by climate model simulations (this is a stronger argument than the co-occurrence of increases in CO2 and temperature)
IPCC
all of those answers, together - it's not just a single anthropogenic reasone.
CO2 and CH4 are greenhouse gases and human activity is significantly increasing their atmospheric concentations.
all of the above
modern versus holocene O isotopes of marine carbonates, etc.
the patter of CO2 and methane in atmospheric gasses
Modeling that shows that natural causes cannot explain observed climate change
Items cited plus other atmospheric effects (other gases, dust), changes in oceanic communities, etc.
Coupled increase in atmospheric CO2 and temperature and the decrease in the carbon isotope composition of atmospheric CO2
stats presented in Thuird Assessment of IPCC
not merely the correlation between CO2 and T, but the expected mechanistic link (greenhouse effect), and the fact that as I understand it, methane and water vapor feedbacks are also positive. 'cooincidenc? I think not...'
Evidence suggests that the rise in temp since ~1960 is not natural (solar or volcanic)
coupled timing of fossil fuel use and CO2 in the atmosphere
The physics of greenhouse gases, as indicated by robust modeling, dictate that the amount of anthropogenic CO2 and Methane should have a significant effect on global temperatures (which is largely confirmed by the recent temperature trends)
Human activity adds CO2 to the atmosphere, but to what extent is unknown. We do not have enough data to substantiate this statement.

The most compelling argument is that many differenct and disparate signals all point to the previous answer. The signals include changes in atmospheric chemisry, ocean temperature, ice volume, poleward migration of tropical species, etc.
rate of climate warming (ocean and atmosphere) in the past 50 years compared to geological record
the totality of evidence from land use changes to changes in green house gases reflected in alterations in phenology and other seasonal signals independent of thrmometers and their placement
The agreement between increasing greenhouse gas forcing agreement with surface temperature change and vertical profile of temperature change (solar forcing would be different in the vertical) and agreement between forcing and paleoclimate constraints on climate sensitivity
there is no single compelling argument but rather force of many different arguments, including our now good ability to model the relative impacts of solar influences, aerosols, and trace gases on temeprature.
coupled increase in T and increase in anthropogenic co2
Data on CO2 and other GHG sources
The physics that relate CO2 change to changes in the earth's radiation budget
Modeling results that indicate that late 20th century temperature increase cannot be accounted for by solar and volcanic aerosol forcing. However, when natural forcings are coupled in models with anthropogenic sulfate and GHG forcing, patterns of temperature increase can be accounted for.
nearly exponential increase in CO2 coinciding with industrial revolution
all of the above and a number of other factors including methane concentration
The totality of all this evidence makes a strong case. Not one point alone can clinch the case, but so much convergent evidence is very hard to ignore or dismiss.
C02 increase in atmosphere matches output for fossil fuel burning, mass balance.
Overall evidence and opinions of specialists
other possible mechanisms are insufficient to explain the magnitude of warming
CO2 levels and carbon isotope composition of CO2; climate modeling -fingerprinting'
carbon isotope values of carbon dioxide
All of the above plus the timing of changes and shift in climatic conditions.
ice core evidence
Correlation with human population is very high
combination of data, including rising air/ocean temps, Carbon isotopic signatures, dates for climatically-driven events (ice melt out in lakes, species blooming/migrating, etc), decrease in ARctic sea ice extent, rising sea level, rising atmos CO2
Basic knowledge of greenhouse effect of CO2. This is not the same as concluding that increased CO2 concentratoins are the cause of the observed increase in temperatures.
(1) is 'evidence' not 'argument'; (2) is argument, BUT not enough options for this to be a reasonable question.
Human release CO2 to the atmosphere at high rates and CO2 is a greenhouse gas
All the above, It is not a single factor but a combination of human activities (deforestation, CO2 increase, glacial melting, loss of biodiversity, etc.)
Replication of 20th century climate in models only if greenhouse gases included
CO2 levels are far higher than pre-industrial times as indicated by ice core data
The entire story is compelling, all that you list plus the basic physics is very well understood and compelling. The most important observation actually you don't list, global sea-level rise as seen by the altimetric satellites.
Quantifing the potential contribution of natural signals and demonsrtating through robust simulation than natural plus anthropogenic signals produe the observed temprature trajectories (as documented in the 4th IPCC report)
all choices and ocean acidification
Climate model simulations can only reproduce observed trends when including anthropogenic forcing
the first two together are pretty convincing
C isotope data, timing of temp and CO2 in glacial cores, etc
agreement of observations with modelling

Data on temperature and CO2 levels as well as GCM model results
there isn't any other way to adequately explain it
coupled change in CO2 and Temperature increase, along with an understanding of th ephysics of atmosphere on radiation balance
the weight of evidence from multiple sources
Computer models demonstrating the amount of effect from natural vs anthropogenic sources.
CO2 concentration tracking
inability of models to explain current warming without both natural variability and anthropogenic forcing
reversal of CO2 flux compared to prior deglacial episodes
Fosil Fuels Burning
Ratios of Carbon Isotopes to Natural Carbon in the Atmosphere
The 'hockey stick' profile in average global temperature, which shows a dramatic rise since the industrial revolution.
the rate of change in temperatures is too rapid for natural causes except volcanic atmospheric dimming
Analogous processes in deep geologic time tell us that high pCO2 corresponds with warm periods in Earth History. We also know that the historic rise in pCO2 corresponds with decreasing d13C values in atmospheric CO2--meaning oxidation of organic matter. The burning of fossil fuels is an obvious source.
Timing of snowmelt and change in timing of streamflow
alpine glacier retreat
Because observed trends in temperature are basically consistent with what our best climate models tell us MUST happen in response to increasing CO2, those climate models in turn representing the state of the art of our understanding of the essential physics of climate.
increasing CO2 combined with retreat of all alpine glaciers
combination of atmospheric CO2 record and recent climate changes including arctic and polar ice
Increased CO2 and other greenhouse gasses due to human activities, as well as loss of sinks
Changes in temperature that not only are in parallel with CO2 increases but which cannot be explained fully by increases in solar radiation.
There is no single factor. It is the balance among several pieces of evidence, including those offered in the list.
rate of CO2 increase and the use of fossil fuels during the industrial revolution.
There are many lines of evidence. No single line is convincing in itself, but together the argument is very convincing.
isotopic changes indicating human source
All three of the listed evidence.
All factors
geology based temperature records
All; however global T leads CO2 rise by 5 months
Recent instrumental temperature measurement
Rise of CO2 correlates with human industrial activity
rate of change in temperature curves in the last 150 years or so
Model studies show that climate simulations without anthropogenic forcing do not reproduce late 20th century warming. Only when anthropogenic forcings are included in the simulations do the models account for the late 20th century warming.
Agreement with predictive climate models
Volume of anthropogenic CO2 released is so large (I do not believe that the correlation between CO2 and Temperature observed in ice cores and sediment records necessarily implies, 'increased CO2 means increase in T', as it is not clear who is the horse and who is the cart in the geologic record.
Melting of Siberian permafrost. Glacial retreats in many parts of the globe
All of the above
modelling studies combined with measurements

Agreement between observations of climate change and model simulations. Only when carbon dioxide increases are included inteh models can they simulate the rise in temperatures over the last several decades.
it is not only the coupled CO2 increase with global temperature increase, but that these both increase at a greater rate than in the past beginning with teh Industrial Revolution around 1900, and that these both coincide with increased buring of fossil fuels.
all of above and partitioning is still not easy
increase appears to have run beyond recent previous oscillations
Inability to model T changes using only natural forcings.
Total balanced climate models
The observed rise in CO2 and the numerous climate models that show the temmperature effect of the CO2 rise.
the most compelling argument is the sum of the data. Picking any individual component is a red herring.
all of the data listed plus other data such as sea level rise and comparison to long term patterns of past climate changes
The preponderance of evidence that includes coupled CO2-T change, ice melting, stratospheric cooling, and lack of competing hypotheses.
The RATES of change from the Industrial Revolution on and especially in the last several decades are unprecidented! The changes themselves could come from known or unknown natural cycles/events but not the suddenness of change.
The correlation in time between the beginning of the industrial revolution and the increase in global CO2 and the rise in temperatures, PLUS the fact that the rate and magnitude of the rise is unmatched in the time period for which data are available from ice cores.
obs co2 + rising T + modeling results
A massive rise in population and mankind's penchant for altering the landscape, not to mention recent (geologicaly speaking), continous industrial pollution of every kind cannot help but have short term and long term effects.
rate of T change compared with Holocene variations
Documented increases in greenhouse gases especially CO2 since beginning of industrial revolution.
I would say that all three are compelling arguments
Fossil fuel burning and atmos CO2 mixing ratios
All data together
All represent significant evidence
IPCC synthesis and conclusion
Increase in Carbon Dioxide concentrations in the atmosphere since the start of the Industrial Revolution. With increased use of fossils fuels, decreased carbon sinks and other associated efects, there has been a distinct increase in CO2 concentrations over the last 50 years.
Community concensus including GCMs
comparisons to ice core records that illustrate CO2 increases related to fossil fuel burning and deforestation have exceeded the natural variability of the recent past
The most compelling argument is that climate models driven with natural sources of radiative forcing (solar variability + volcanic eruptions) do not reproduce the observed temperature trend, while models driven with natural radiative forcing plus greenhouse gases do
model predictions with and without CO2 increases
Model simulations of the observed warming
It is hard to imagine CO2 exceeding values for the past 500,000 years with no consequences
Coupled CO2 increases and O2 decreases exactly correspond to the amount of fossil fuel combusition suggested by sales data from the petroleum industry
patterns of warming (stratosphere vs. troposphere; poles vs. tropics; day vs. night; etc.)
fossil fuel combustion over past 150 yrs has converted carbon into atmospheric CO2, increasing atmospheric CO2 levels, and increased atmospheric CO2 has increased global temperatures through the greenhouse effect (trapping long-wave radiation within Earth's atmosphere)

the most compelling argument is all the peer reviewed research
Loss of sinks (e.g., deforestation) coupled with the increased production of CO2 and others through energy use, etc
fact that research on cave speleothems, ice cores, dendrochronology, etc. etc. ALL support the same conclusion
It is the coupled change in CO2 and temperature, but, very importantly, the underlying physics (1st law of thermodynamics, Planck's Law) that explain why CO2 affects global temperature
all of the above in addition to other indicators like rates of anthropogenic emissions, surface ocean temperatures
humans have burned fossil fuels for several hundred years - the atmosphere contains the CO2 from this process.
All of the above and the increase in night time temperature and the amplification at the poles
increase in GHG inventories at a pace with which Earth's cycles cannot keep up.
the basic physics of an increase in atmospheric longwave absorptivity
Climate models, both simple and complex that incorporate solar energy received, albedo and greenhouse gases, do a great job of matching climate observations. Without anthropogenic greenhouse gases, the warming since the mid 1970's would not have been.
correlation of rising CO2 and human population since industrial revolution
comparison long-term with pre-indutrial paleo record (tree-rings, etc.)
detection by measurements and attribution by coupled climate models
ice cores
multiple lines of evidence from paleoclimate reconstructions coupled with the contemporary manifestation of past (1980s) predictions, and alarming biological changes and ice retreat. When you consider all of these potentially circunstantial lines of evidence together along with the physical knowledge of the so-called greenhouse effect that has been understood since the late-1800s its kind of a no-brainer. The pieces all fit together ... it took a long time for geologists to buy into continental drift (plate tectonics) even in the face of overwhelming and elegant evidence. Global climate change and the paradigm shift that is occurring is much like the resistance - growing recognition - and broad acceptance of plate tectonics theory.
Extensive use of fossil carbon fuels
All of these, plus the reconciliation of land, satellite, and atmospheric temperatures
All evidence examined together.
known increase of atmospheric CO2 and our knowldege of covariation of CO2 and global temperature from the paleorecord (in particular over glacial/interglacial)
The relative rate of warming compared to past historic and prehistoric warming periods similar to todays warming... the close parity of CO2 and this warming trend climb at simlar rates and the CO2 can be isotopically tagged to anthropogenic sources. So, not only is there a tie to a modern anthropogenic source, but the because the rates of increase are roughly parallel it is statistically likely that they are coupled (CO2 and temperature rise).
improved global circulation models that can reproduce past climate changes
Greater increase in nighttime than daytime temperatures, indicating the atmosphere is inhibiting escape of infrared to space
none is most all are important
1 and 2 above
All of the above, particularly when viewed in light of the deep time history of climate change - it is clear that dramatic changes have occured repeatedly in the past, but the rates of change we observe now, on all fronts, seem to exceed those documented in the fossil/rock record.
all of the above
extensive alteration of landscapes including deforestation and urbanization
I'm not sure that one argument, taken by itself is compelling. It is the exsitence of various lines of evidence that, when taken together, provide a compelling case.
basic physics
Physics associted with increased CO2 levels in the atmosphere and heat energy balance of the Earth.
all of the above
all of the choices coupled with an explosion in human population which results in demand for food, energy and land

Combo of all the above
rate of glacier and ice change plus rate of increase of surface and atmosphere temperature change with CO2 plus agreement of observations with climate models, plus observed climate changes in my region. It's the TOTAL picture that's convincing.
Clear historic correlation of CO2 and temperature and the dramatic (and historic) increase in CO2 in the past 100 years
the multiple lines of evidence- temperature increase, loss of ice, changes in phenology
Climate modeling and comparison with observations with and without CO2 emission and forcing terms.
a combination of rising temperatures, rising CO2 concentrations and global carbon budgets as compared to fluctuations in sun energy and volcanic activity
That was pretty kmuch pre-industrial. I also endorse the other answers to this question, but I'm most convinced about the natural signal because we can document it over thousands of years.
The clear mechanism, documented in almost 1 million years of data, linking clear data on CO2 increases due to human activity to greenhouse warming effects. It's much better than a simple correlation coupling- it's highly incorrect to suggest that.
Documented warming (boreholes, changes in native hunting/fishing areas, permafrost decrease) in high northern latitudes
Many lines of evidence are consistent with expected outcomes from altered greenhouse gas levels. So no one piece of evidence is 'most' compelling; the combination of various lines of evidence is what's compelling.
Climate models only show the warming when anthrpogenic greenhouse gases are included
The coupled *rate* of change in atmospheric greenhouse gases & temperature - has accelerated in past 150 years
I don't see that the 3 choices given are all arguments for--how can the loss of sinks be an argument for human activity changing temperature?
A and B; both the rate of sea ice melt and the relationship between rising CO2 and temp
combination of CO2 and temperature statistics with changes in human activities
Humans now dominate the biosphere because of our numbers and apparent needs and use of resources, especially water and arbon-based fuels.
Understanding of the chemistry and physics of greenhouse gases, and the high degree of correlation between high pCO2(atm) and global temperatures as indicated by the geologic record (ice cores, deep sea cores, etc.).
Climate modeling evidence showing that recent temperature rises can only be explained if forcing due to anthropogenic greenhouse gases is included
The fact that temperatures started rising considerably after the industrial revolution relates the CO2 increase rise with the burning of fossil fuels. Mathematical models that consider only the impact of natural sources of CO2 do not reproduce the change in temperature that is observed. Mathematical models that consider exclusively the warming produced by anthropogenic CO2 do not reproduce the observed change in temperature either. It is the combination of both sources of CO2 the one that provide the best match to the observed rise in temperature
one element answers are not sufficient: all of the above plus the beginnings of large scale world wide ecosystem modifications
physics
it's not possible to reproduce the observed temperatute change in climate models without including observed greenhouse gas concentrations
All of these are compelling arguments, plus the thermodynamic theory that explains atmospheric energy flux and CO2 influence.
PHYSICS
It's the matrix of changes that, taken together, that make for a compelling argument..
ocean temperature
Clear dynamical linkages between increase in the atmospheric concentration of CO2 and warming of global climate, as simulated by numerical models of climate
Rate of change is far greater than seen in geologic records
Global circulation models that use the best data and thermodynamic information
consilence of evidence, correlation between GHG's and climate changes; absence of other forces (e.g., sun's output); rates of change accelerating; connection of some critics to interest groups

paleoclimate records (ice cores and proxies) that show strong agreement between CO2 levels and temperature
coupling of CO2 increase, temperature rise, triggering of ice melt, ecosystem response to climate fluxuation, and removal of key ecosystems
much higher levels of CO2 in atm than anytime in previous 400,000yrs
modeling of climate forcings shows that the observed increase in temperature cannot be accounted for without including forcing from fossil CO2 and other greenhouse gases.
the combination of the basic physics of the enhanced greenhouse effect and the several lines of evidene that the extra GHG come from human activity
Coupled change is important, but also all the experimental evidence for greenhouse gases and their effects
ice core data
Stable isotopes mainly C-13 data of CO2
change in atmospheric 13C/12C isotope ratios over time
All of the above and more...I am a believer in multiple lines of evidence
all
It is several things. The coupling of CO2 and Temperature, the unprecedented rate of change of both, and the negative evidence that other natural causes of climate change are insufficient to explain the coupling.
GCM results
The evidence is along a multitude of fronts. It is the combination of multiple observable changes in the environment, with known human activity, and thermodynamically demonstrable forcing functions that persuade me that warming is happening and that humans are significantly responsible.
temporal and spatial pattern of temperature change
rates of change way out of syn with natural rates
higher temp rate of change than any time documentable
melting alpine and glacial ice and contemporary and historical photographic evidence thereof
relative magnitudes of natural and GHG top-of-atmosphere radiative forcing
The temperature data is flawed and inconclusive
The pattern of change is consistent with the pattern of change predicted by climate models forced with elevated CO2 levels
attribution exercises
The fact that models that include human CO2 input to the atmosphere reproduce the observed temperature trends. Models without human caused CO2 do not.
even though #2 is the most compelling, but there seems to be some decoupling between them that has not been explained
A combination of the coupled rise in CO2 and average T: but also the rate of rise of CO2 and population versus normal rates of rise in interglacial periods
coupled change, plus C14/C12 ratio showing the increase is fossil carbon
Attribution studies using climate models
stable isotopes changes
manifested by changes in the physical chemistry of the atmosphere and land-surface changes
CO2 release + reduction of natural CO2 sinks
All of the above!
Depending on how far back you want to go in geologic time, the question is not well phrased
when natural causes of climate variability are removed from the global mean temperature trend, the residual is similar in nature to the shape of the anthropogenic CO2 curve
A plausible physical mechanism (greenhouse gases) coupled with supporting observational data in the context of longer-term (millenial-scale) climate change records.
urban heat islands

Unprecedented levels of all greenhouse pollutants (not natural gasses) input in the atmosphere; to my understanding should have some impact on temperatures. The 'curve matching', though, is not enough evidence by itself.
Agreement of modeling results with climate data.
Accelerating rate of CO2 inputs that appears unprecedented in geological record, with possible exception of PETM (Paleocene-Eocene Thermal Maximum.
CO2 level drastically increase after industrial age
The coupled CO2 and temperature increase along with climate models that predict the same result
global climate model results
Mauna Loa CO2 data combined with knolwedge of Industrial Revolution and related use of Fossil Fuel
I don't think the question is worded well. The evidence comes for example with coupling of CO2 increases in ice cores with rise and changes in civilization.
Simple physics of global warming
Amount of and steepness of increase of CO2 since the beginning of industrial era far exceeding (> 20%) previous maxima reached by the natural cycles as inferred from ice core CO2 data
We are burning fossil fuels producing CO2, a greenhouse gas, we are deforesting, increasing agriculture all of which produce CO2 and reduce sinks. CO2 levels are rising etc...
Detailed analyses of 3-D patterns of observed changes in climate varibles.
C isotope evidence of burning fossil fuel + T v. CO2 correlation
retrospective modeling
What I read from people I (mostly) trust.
Only by including both natural and antropogenic effects can we accurately simulate climate
All of the above apply, but not sure how significant the contribution is. Since there seems to be a contribution I feel the we should err on the side of caution, not sweep it under the rug.
population increases coupled with percpita consumption of hydocrbons.
Decreasing d13C of atmospheric CO2
Human activities that can 'trip' the balance in very delicately balanced oceans/atmosphere/biosphere systems.
The combination of all the factors that you listed, plus the increasingly rapid rate of changes that the IPCC documented last year.
isotopic data on specific man-made compounds
Observed temperature changes are consistent with the theoretical and modeled responses to increased greenhouse gases.
overall rates at which all of the items listed as options are occurring - very fast, compared to what we normally predict such rates to be if part of the normal cycles of climate change (with exception of volcanic eruptions totally disrupting the climate)
certain feedback curves (I don't remember all the parameters) suggest that at this point in time after glaciation global temperatures should actually be falling not rising -- comparred to previous 12 glacial cycles.
coupled atmospheric CO2 and T combined with numerical modeling
all of the above, with added emphasis on the arrogant and wasteful attitudes of humans. Hey, lets go out and buy a Hummer and complain about the price of fuel.
Climate forcing mechanism (solar input, vocanism, etc) when decoupled ro the existing rate of change demonstrate that a change has still occurred... that change matches with CO2 emission increases and the development/progression of agricultural activities. The rate of change is unprecedented when ice cores are reviewed.
we have seen a rapid rise in temperatures that is consistent with predictions of computer models
No single argument - many consistent pieces of evidence
climate models reproduce change when CO2 forcing is included
The answers may be evidences or mechinisms by does not provide an evidencary relationship with human activity.
detection and attribution studies summarized in IPCC AR4 (2007)
rising CO2 and other greenhouse gases contribute to a positive feedback mechanism. Although humans probably are not solely responsible, we are contributors. The argument has both theoretical and empirical compontents.

APPENDIX C (continued)

Estimates of net GHG emission from natural ecosystems vs. human activities
Since 1800 (about 200 years ago) we have released into the atmosphere approximately half (if we are near the peak of world oil production) of all the carbon sequestered in Earth's oil and gas deposits over the past few billion years.
basic physics
links among industrialization, increases in CO2, and increases in temp
observations of differential heating in the troposphere and stratosphere
discrepancies in comparing today's situation to paleoclimate data
All of these reasons plus the physics of response to radiative forcing plus the modeling results.
Physics and cjemistry of greenhouse gases plus ocean and air warming
GCM results that demonstrate that recent warming is in part due to increases in greenhouse gases
The major impact humans have had on the entire Earth; e.g. the huge amount of CO2 released into the atmosphere in light of the thinness of the atmosphere; other human impacts such as ozone; the record of the nature and magnitude of past climate change in Earth history and the rate of change today, etc.
All of your factors are important but it is the dramatic increase in the RATE of change that is so significant.
Increase in greenhouse gases (and related understanding of radiative forcing)
model calculations
all of the above
ozone hole
Loss of CO2 sinks and human output of CO2 and other greenhouse gases
The IPCC reports
Land use changes
In light of the current warming, it's the CO2 increase at Mauna Loa _and_ the chemistry that clearly shows the CO2 source to be anthropogenic
Release of excess heat from Carnot cycle technology
Things I've heard experts say about study results.
results of climate models that are able to duplicate modern temperature changes only when anthropogenic forcings are included along with natural forcings
There is a whole host of things that have contributed to the increase in globally averaged surface temperatures. To list them: 1. CO2 emissions (as well as other long-lived greenhouse gas emissions). 2. Deforestation (removes a sink for CO2) 3. Warmer seas surface temps (warmer ocean temps means less of a sink for CO2). 3. Aerosol direct (scattering off of aerosols) and indirect effects (changes in cloud albedo and lifetime). 4. Darker dirtier snow (lowers the albedo which means it absorbs more of the sun's energy and thus melts sooner). 5. Greater demands on our earth's resources by a booming population. 6. Changes in the surface albedo due to deforestation, cultivation and urbanization. This is just to name a few…
climate models cannot produce the warmiing we've seen without adding CO2 and humans are the producers of CO2
first two are the most compelling.
carbon isotope geochemistry of atmosphere clearly shows CO2 is due to the shift of carbon from organic matter (wood burning, fossil fuel, etc.) to CO2 in the atmsophere and ocean. Natural processes would not produce such a signal.
All three options are integrated. I am unable to distinguish one from another.
all 3 arguments combined
None of your suggested anwers are anywhere near the right answer! The right answer is that theory leads to prediction, and the prediction has been met!
The numerical climate modeling results which give evidence for a direct relationship between the increased greenhouse gases and the warming.
All of the above; also RATE and MAGNITUDE of observed change
It is the combinatioin of climate data, data on greenhouse gas concentrations, and the results of numerical models that together are convincing. Despite the shortcomings of the numerical models, they have made been useful to make predictions that are within the 'ball park' in terms of the climatic patterns.
Several data and anecdotal observations including my own

modeling of contributions to temperature change
all of these+more detailed scientific evidence
Ice Core Data
Greenhouse observations supporting the greenhouse effect, climate and atmosphere of Venus, linkages between rising atmospheric CO2, fossil-fule CO2 releases, and atmospheric temperature; supporting atmospheric isotopic evidence pointing to fossil-fuel emissions as the reason for the rise in atmospheric CO2
Calibrated numerical model (GCM) results
All of the options provided
Increased temp since 1900
melting glaciers, increasing global temperatures, loss of forests, warming of oceans, more CO2 in the atmosphere
None of the listed arguments supports anthopogenic climate change, just climate change in general. The strong temporal correlation between rapid warming and industrialization is compelling.
basic understanding of how the atmosphere functions to regulate temperatures
Coupled increase in global temperatures, increase in CO2 produced by man, and the fact that global climae models using the increased CO2 amounts quantitatively produce the observed temperature increases, showing that the two increases are not a coincidnece, but cause and effect.
the change in carbon isotope ratios in the atmosphere in combination with the increasing CO2
all three
a bit of all of the above (it's complicated)
Rate and magnitude of temperature changes
agreement between models and data
Understanding of greenhouse effect and rise in atmospheric CO2
ice core samples and other measures of CO2 since the Industrial Revolution plus other evidences
all three. The changes are complex and to some degree may be non-human in origin. However, given the evidence that that there are obvious changes in weather patterns, exponential increase in human population and human consumption of resources, and loss of permanent snow fields in mountains as well as retreating glaciers; it is pretty obvious some important, negative things are happening.
Changes in CO2, temperature & sea level are consistent with model predictions based on human activities
consensus agreement by thousands of climate scientists
Co2 concentrations seen today vs. past 4 interglacials as recorded in ice core data
no one argument: confluence of multiple observations
Rapid change in vegetation communities worldwide and migration of plant species
Not sure we know yet
All of the above
Coupling of atmospheric CO2 and average temperatures over geological timescales, coupled with human-caused increase in CO2
all of those plus measured releases of Carbon
Correlation of change in T and human population
Coupled increases in CO2, increased in other anthropogenic gas emissions, and rapid increase in the rate of warming
The physics of IR absorption by greenhouse gases in the atmosphere.
the first two answers
combination of anthropogenic greenhouse gas emission and deforestation
all of the above
Models matching the temp;eratures for the last century.
In part, the observed correlation between atmospheric CO2 concentrations and global mean temperature, as well as a body of modelling results that indicate that the observed range in temperatures since 1900 is beyond the range that can be explained by natural variations.

APPENDIX C (continued)

It is a combination of the rising air temperatures, the melting of the glacial and sea ice, and the gain in heat content of the oceans all happening in an environment of rising CO2.
deforestation, advent of internal combustion, other forms of pollution
Plant and animal movements to the higher latitudes
Coupling between global changes in temperature, CO2, deforestation, CH4 production (agriculturally forced), and atmospheric black-carbon particulates (from diesel and industrial emissions)
I think it's a mix of deforestation and incrased CO2 levels.
CO2 in atmosphere is known to absorb heat; CO2 has been rising over the past ventury or more; Human sources of CO2, mainly from fossil fuels have also been rising can contribute a significant % of the rate of carbon input into the atmosphere.
first two
all of these
It's expected based on increased carbon dioxide release and the greenhouse effect
theoretical link between atmos CO2 and T
all three
all 3 of your choices
Answer is much mor complex than any of these. The evidenc eis overwhelming that the radiative forcing on cliamte from increasing greenhouse gases and particles are driving the climate change
temperature based on sun, orbital and other trends should be going down, it isn't
To go look for (and thus pint point) a single consequence
These are all converging lines of evidence that address the correct scale of action.
climate modeling that does and does not include increased CO2 forcing
increase in atmospheric CO2
The sum of all the evidence including coupled CO2 temperature increase, carbon isotope change, and modeling results.
Growth in human population and demand on limited resources

Write-ins to Question 3b

solar activity but maybve decrease in solar flares and increaseing sloar cycle times
The extremely rapid increase in global temperatures over the past 10 years and the ability of numerical models to simulate the increase
Much better correlation between solar energy and surface temp. then CO2 and surface temp.
We are in a pattern of recurring natural climate cycles that exactly predict the past 30 yrs of warming and the current 10 yrs of global cooling (yes, COOLING!) as confirmed by all major global temp measuring systems. In addition, of the past 28 warming periods, only the last one could have involved CO2. Also, the precise correlation of solar variation with climate changes is more than just coincidental. No real, physical evidence exists that CO2 is the cause of the past 30 years of warming and all of the previous warming occurred BEFORE significant manmade CO2 emissons.
All of the above
increased solar wind intensity
It is orbital, natural, and solar cycles combined
Both natural climate cycles and solar activity
The carbon dioxide theory is based on compouter output. Short term changes in Global Climate cannot reasonably be connected to a rise or fall of ten or so parts per thousand of carbon dioxide.
Complex feedback systems causing advance and retreat of great ice sheets
There are likely a number of compounding natural factors including the ones you list (i.e., Milankovitch cycles, solar radiation output/cycles, etc. This does not mean that CO2 output from man-related sources do not contribute in a minor secondary manner; however, there is abundant, non-politically driven scientific studies that would indicate the primary causes of recent (last several hundred years) climate increases are the result of natural factors and not man-related activities.
the increase in temperature does not correlate with the increase in CO2. It appears more tied to some kind of natural cycle.
Your first two choices appear reasonable as possible causes of global temperature change. Also, I am aware that the Quaternary glaciations occurred and abated, with at least 4 major peaks, prior to people evolving and/or prior to the industrial revolution. In addition, the most recent warming commenced at the peak of the Little Ice Age, about 1680 but certainly between 1650 and 1700, at least 100 years prior to the start of the industrial revolution and at least 200 years prior to the major use of fossil fuels by humans.
ca 14,00 yr ago Great Basin contained many large lakes & Sierra Nevadas had may glaciers. Currently ther aare only a few lake remnants & the glaciers have all melted. This process began pre-industrial revolution and pre-major carbon releases by mankind
All of the answers.
All of these combined, preferencial funding and media hype
Global climate records of the last 60 MY.
We cannot separate out, with adequate precision, the different factors.
multiple lines of data suggest humans are not the first order drivers of climate
There temperature record is not long enough to form any significant hypothesis regarding the cause of the observed temperature increase. What we are probably experiencing is random variability imprinted on long term cycles such as milankovitch, and shorter cycles such as the amount of solar insolation due to sunspot activity and forcing by other similar natural phenomenon. Compared to the natural sources of greenhouse gas input, the amount of greenhouse gas generated by humans is relatively insignificant.
n/a
Climate has been changing throughout the Holocene for uncertain natural causes. Perhaps it is solar output, but I don't think that has been ascertained with strong evidence. Nonetheless, for whatever reason the climate has constantly been changing and there is no compelling reason to believe that human activity is the current cause given that the current increase began 150 years ago, well before human activity was sufficient to create change.
all of the above
I think the climate record is far too incomplete, that the impact of solar input and volcanic inputs are poorly known and that our ability to accurately model the climatic system is far to immature and untested to rely on current predictions
Effects of solar radiation and solar wing on outer atmosphere layers

Throughout geologic time climate and temperature have had very large variations. Right now, we are on a 4oo year overall rise, and part of a general rise since the end of the last galciation 14-18,000 years ago.
Current climate falls well within geolgic norms and recent increases in CO2 lag behind 'correlative' rises in temperature.
it is human and natural envionment, one needs to separate cause and reaction
data sets feeding models is incommplete
global temperatures changes do not mirror steady CO2 increase
both 1 and 2 and current global records do not cover a significant enough length of time to make the types of projections that are being made
See Jan Veizer papers
temperature increase follow sunspot cycle length
Combination of A and B plus - we don't know how climate actually works
warming and cooling cycles have been occurring since the earth was formed
Data
There are indications that natural terrestrial processes are at work including cyclical ocean currents. In addition solar energy output needs to be studied to determine what sorts of fluctuations can take place and have taken place, and, what these fluctuations mean to Earth's climate. (Just to mention a couple.)
All of the above
All three choices contribute to global climate cycles
All of the above and that the time interval and random geologic process has a greater impact. Human activity only exaserbates the temperature rise. But we are at a deliquate point of balance in S.L. fluctuation and need to try to keep the surface cool.
solar ouput differences observed over the past fifty years and estimates of planetary warming on Mars
modelling

Write-ins for Question 4

98%
99%
99%
95
99
98
99
98
don't know
98
95
95
98%
96
over 90%
98
99
dont know
99%
95+%
99%
98%
98.5
98
99
95%
95%
95
don't know
97%
99
98%
98
more than 95%
95
Might be 100% - I've not asked all colleagues, but I no of none that think human activity is no a contributing factor.
98%
95%
98
95

95%
98%
97%
99
>50
95
97%
>95%
99
99.0%
95%
I do not know
95%
98
97%
99
99
I don't know
98
99
99%
99
99%
95%
98
99%
greater than 98%
95-99
97
99
95
97
98
90%-100%
97%
don't know
95%
95
99
95%
98
?
95%

99.9
98
98
95%
95%
98
98
95%
95
98
99
98
98
98%
98
99.8
99%
98%
98%
95
99
97%
95
85
99%
99%
95
99
98%
98
99%
98%
97%
>90 but <100%
academics - near 100%. Oil and gas industry - closer to 50 %.
99
99
99
98
99
98% I think the remaining 2% are paid to disagree.
Don't know
96

98
99%
99
99
98
98%
99
95%
99
~98
98
98 %
95
?
99
NA
??
nearly 100
98
95
99%
>98%
I don't really know. It's not a consensus issue for all academics to it is for most.
99
98
99
99%
97
Arounfd 98-99%
95
95
95
most, presumably - although I'd say most are also like myself in not having any real strong scientific reasoning behind that belief. In other words, clear it's warming (from the ice) and clearly we're messing with atmos composition and land surfaces. And, it seems logical that these two should be connected. But over 90% of geoscientists I know couldn't give a stronger argument than that.
95%
99
99%
99
98
>90%
Just a guess, 50%
95%

99.5
99.99%
don't know
I have no idea
I find it interesting that geoscientists tend to be influenced by their career position. My friens in academia are almost all convinced of the anthropogenic influence, my friends in the energy and minerals sectors seem to think it is natural
95%, I've never spoken to anyone who thinks strongly otherwise. The 5% are for the people who I have not spoke to who are probably out there and/or whos scientific research may show contradictory evidence.
99
85
98
>90
99% -- Not all but just about all
95%
somewhere between 80 and 90%
I don't know
98% of active, credible geoscientists
99.9
I haven't polled them so I couldn't say. I would say that 85% probably feel it is a contributing factor, but that other factors and feedbacks may also be important. That is the problem with this simplistic type of survey. It isn't a yes or no question necessarily .. there are shades and nuances.
98%
30% will agree that we are seeing it already BUT 90% will agree that we will see it definitely in the future (next decade ot 2)
95
98
95%
98%
>99
more than 95%
99
I would suspect more than 90 percent, but I really do not know as I know of no survey of geoscientists on the subject.
Almost everyone; I couldn't put a specific number to it though.
98%
95%
>95%
99%
99%. Answer to previous question (the form would not take the response on the previous question): Basic physics of radiation and greenhouse gas absorption permitted this effect could be predicted at about the same levels since the 1979 Charney report. Subsequent temperature rise has confirmed predictions Made in advance of the temperature rise.
99%
I appreciate the limitations of this survey method, but I'm not sure that simplifying complex questions this way is all that helpful in understanding how science is done. Most scientists acknowledge uncertainties in hypotheses so asking black/white questions like this (you either think it is or think is isn't; you're not allowed to think that it may be). For example, I might I guess that 80% of my fellow geoscientists are at least 50% sure that human activity may be at least 50% responsible for global warming.
don't know

95
98
Interesting that operational meteorologists often disagree, whereas research scientists who scrutinize the evidence are largely (90%) convinced
I would think most of my coworkers, but I can not answer for the geoscientist community in general.
99%
98
98%
95
95%
99%
99%
95%
99
95
98%
99%
No idea
99
99
>90%
99%
no opinion
98%
don't know
no idea
?
dont know
I have no idea
???
I don't know
I don't know
95
Science is not based on votes or consensus. Irrelevant question. Besides, which scientists do you regard as relevant?
a fair number, but no idea
95%
I have no idea - and I do not think that a concensus has anything to do with whether a hypothesis is correct. Check out the hisotry of science...you will find that scientific discovery is generally made by ignoring the 'concensus.'
don't know
What climate change? It is warming up but that's not the same thing. How do you measure climate change?
I have no basis to estimate this.
don't know
Not Fair: You changed the question from 'significant' to 'contributing' Significant= 25%. Contributing=75%
do not know

99
Isn't that the purpose of your questioning?
No idea
This is a nonsense question because it isn't black and white. Human activity affecting climate is a hypothesis in need of testing, and what we think is somewhat irrelevant
no idea
I have no idea
Don't know
Because no one has taken a poll, no one can know this.
Those that believe this are either making money from it or have a poor understanding of radiative forcing in the atmosphere.
If contributing means or includes CO2 output being a secondary factor, than likely 80%. If you mean it to be the primary factor, then more like 50%
I think most would agree we have an effect. The question is to what degree do we affect change
don't know
86%
?
Unknown
97

Write-in for Question 3c

There are natural cycles of different frequencies/wavelengths which might be responsible; one study suggests it'll be 2040 before these cycles will start to go a different direction from what we've seen recently. Only then will we be able to tell for sure.
The timing is following historically determined cycles for the past 3 thousand years.
While I think its very likely I am not yet 100% sure. There is at least one idea - change in atmospheric ion formation affecting cloud nucleation owing to solar activity.
(1) I haven't spent much time analyzing the data personally (mostly because of time limitations and the topic being outside my area of expertise). (2) I don't fully understand the complexities of all of the variables involved. In other words, I don't believe that I have an adequate grasp of the interactions between earth-rbital cycles, variability in solar output, albedo, or natural vs. human input of CO2, etc. to have a sufficiently formed scientific opinion of human-induced climate change. (3) It's fairly obvious that humans are having an impact on the planet, but again, assigning 'significance' to that impact is difficult for me to assess scientifically.
(I am interpreting 'changing mean global temperature' as meaning the changes since 1800...) I think its very clear from a theoretical point of view that anthropogenic activity can, and probably will, impact climate. My uncertainty arises from the apparent complexities of attributing changes in the last century or so of observed record, given the small signals, significant natural variability, and potential trade-offs between anthropogenic forcing influences.
1) I do not have a clear understanding of the relative signigicance of anthropogenic CO2 and other greenhouse gas sources, including natural sources of CH4. 2) I am not sure about how much CO2 and other gases are staying in the atmosphere to act as greenhouse gases, i.e., what influence do/will sinks and cycles have in the long term residence of these gases in the atmosphere? 3) I am sure of the remarkable sea level excursions of the Pliestocene and before. These appear to be the norm in geologic history convincing me that we are most likely living in and witnessing a natural warming trend and natural sea level rise. I do suspect human activity adds to and maybe even accelerates the warming. I also suspect that if mankind could cease all greenhouse gas emissions this very moment we would still see warming and sea level rise continue, albeit perhaps a bit slower.
1) Our temperature record is weak (because the period of instrumental measurement is short). It is, in all truth, not possible to get to statistically satisfactory proof that there is indeed a net upward trend. We assume that it is so, but we have to remain cautious. The same goes for human contribution to warming: it is highly likely that there is a significant contribution, but we should be careful with what we say.
1. Previous fluctuations of greater magnitude have occurred without the human contribution. 2. Data suggesting that global warming is due to human activity is unconvincing. Most of the statements that we see in the press and in the political arena are not based on fact, but emotion and the desire to state something sensational.
1. Solar variation/insolation long term data is not sufficient for eliminating this factor from consideration. 2. As a geologist I recognize that global temperature varies on certain time scales - for example Cretaceous versus Triassic. Thus the amount of temperature increase as a result of natural processes over a long time interval may be the more important aspect and the human factor may only be a blip on the curve. 3. Lastly, define your terms - this question and the early one asks about increasing mean global temperature - supply me with some values and error bars and then it can be evaluated.
1. Incomplete understanding of the natural rates of climate change throughout the geologic past; 2. Awareness that historic global climates have been cooler than average for the Cenozoic
90% of Earth history has been warmer than it is today and mankind has been an industrial polluter for a scant fraction of that time. Most of Earth history was warmer for other than anthropogenic reasons.
A few respected dissident voices in Earth Sciences.
A very good question to ask is this: are the warmer post 1850 temps due to the controls forcing the Liitle Ice Age being relaxed or inoperative? Exactly how much of this increased temp scenario is due to the answer of the former question and how much is due to land cover changes (an often forgotten factor) and then finally co2 emissions?
Alterate hypotheses for global warming associated with sun activity exist.
Alternative hypotheses have not been proven wrong.

Although there is good evidence of recent influences of humans on temperature change, we are in a post-Pleistocene glacial period. For example, the sea level rise since the last glacial maximum is clearly not driven by human activity.
Ambiguity of 'human signature' found in climate trends; short time window of possible human contribution to climate.
Are we seeing a natural cycle of temperature changes. Human activity probably is a contributing factor in any change, however the question in my mind is just how much and which way have the activities contributed.
As I see it there is an incredible amount of 'noise' in the discussion of climate change. The idea of climate change as a byproduct of increasing CO2 by burning hydrocarbons seems reasonable to me however, I have yet to see a collection of definitive studies about the Pleistocene rates of change in comparison to what we are seeing today. An example of what I mean by 'noise' in the discussion is the idea that in a single year of increases hurricanes activity on the Gulf Coast is somehow directly related to 'global warming'. This idea often gets muddled with the projections that we will in the future experience more server weather patterns as a byproduct of global warming. Climate change is a difficult topic to teach. I usually leave it at any environments change that occurs at a rate that is slower than an organism ability to adapt is OK. If the rate of change is great that the adaptation rate then that organism is in trouble. I also remind my students that 90% of the earths atmosphere is within 60
Based on 32 years of geologic experience, I am quite certain that the impact of any anthropogenic increase in Co2 is very minor when compared to geologic and astronomic causes.
Because changing global climate is a natural process that has been going on since the Earth was formed with temperature fluctuations much greater than has been recorded since the 1800s. So how can we remove the natural signal to determine the significance of human input.
Because I do not have confidence either in the temperature measurements as a proxy for heat content of the atmosphere, nor do I feel that the link between CO2 and increased temperature is clear cut. This does not mean I do not 'believe' in this effect, it just means I'm unsure of the data and the interpreted connection between human activity and temperature.
Because I know good climatologists who explain to me the complications in this assessment.
Because I personally do not understand the buffering capacity of the oceans in terms of sequestering CO2 as carbonate. And I bit familiar with studies on the the effects of changing ground usage on albedo.
Because mean global temperatures seem to have actually been increasing since before the beginning of the 'industrial age'. So it appears that it may not purely be that human activity is a 'significant' contributing factor.
Because of the long period of pre-human Earth history characterized by significant climate change (both periodic and random).
because of the unknown factors, such as solar activity and natural methane releases.
Because 'significant' requires qualification and because mean global temperature is always 'changing.' I don't believe that we have sufficiently established all the 'contributing factors' underlying global temperature change to be able to assess significance.
Because the climate has been warming for the past 18,000 years. We do not have high enough resolution of temperature date over that time period to differentiate between short term variation and long term trends.
Because there are also natural changes that could happen, and it is difficult now to decide whcih is the more important, natural or human activity.
Biased reporting of environmental facts are skewed, thus the relative impact of anthropogenic change versus naturally occurring change are obscured. When one looks beyond the news, many other factors for climate change emerge.
Cannot adequately separate out the effects of natural factors that alter climate
Climate change has been a most common natural factor throughout geologic time
Climate change is a natural, geological phenomenon. Humans surely have had an impact since the beginning of the Industrial Age, but determining this impact will be difficult - relative to the geologic/meteorologic perspective
climate has varied widely even before the population increased to today's levels
Climate is a very complex system with many variables including sun radiation cycles, ocean temperature, and possibly other factors that we are not even aware of. There are studies and data out there that are being overlooked by the IPCC. Ultimately, maybe we are the biggest cause or maybe we are not, but the current push of saying that human activity is the cause is interfering with an unbiased and scientific evaluation.
Climate might be warming anyway without human influence. There is probably a chance that human impact may be amplifying an already increasing trend..
Climatic change is normal under natural conditions. Man may or may not be accelerating present rise in temperature.
climatic changes are driven by numerous factors. Human activity has a role, but your use of 'significant' needs to be defined more specifically

CO2 concentrations have risen in the distant past. Is that an effect or cause of global warming? I don't think we know.
CO2 increases, sure, but what are the other contributing factors
CO2 is one factor in many that contributes to behavior of complex, non-linear system for which current climate models are very rudimentary.
Complexity of system and natural cycles
conflicting reports
Correlation between CO@ increase and temperature increase is not convincing and contains significant lags between peak temperature and Peak CO2. Increase in CO2 since 1950 has been constant while increase in T has not.
Correlation of human-enduced CO2 emissions and temperature is not the same as causation. It is difficult to completely eliminate other contributing factors such as solar activity.
Detailed scientific data from numerous locations around the globe
Difficult to assess all contributing factors.
Direct evidence of human activity as a factor is missing. Attributing human activity is based on computer models.
Earth has increased in temperature many times in geologic past.
Earth is an exceptionally complex system which is inadequately understood. Natural processes clearly play a dominant role in climate change. Isolating the human contributions to climate variability has not been well documented and is primarily model driven at his point.
Evidence to date for a connection is tenuous
Existing reliable data on mean temperature range is too short-term to be clearly differentiated from the overall post-glacial warming trend. Proxy data are not convincing in terms of causality.
Far more empirical data needs to be obtained which can be correlated to temp. changes with human activity. Selection of sitesfrom which cores are collected is important.
First of all, 'Significant' is undefined, and to achieve the statistical parameters of sigificance is much of what the debates are about. More importantly, there have been many substantial global temperature changes in times well before humans that we cannot account for. The bigger question is, 'How much [warming] does human activity add?'
From a geological point of view - that is, looking back over millions of years of history - there have been times when the temperature and CO2 contents have been way above the current values, and humans were not involved in any way. I also don't understand why the dominant greenhouse gas - water vapor - is rarely, if ever, talked about in popular discussions of climate change.
Fuzzy statistics
Geologic history
Given the fact that temperature fluctuations in the geological past have occurred without the activity of humans, I am uncertain if humans are a SIGNIFICANT contributing factor. I have no doubt that humans are a contributing factor (e.g. every time in the geological past when carbon dioxide goes up, so does temp.--and we have surely added that gas via fossil fuel burning and other activities.
Global change has been going on throughout geologic time, long before human activity could have been a factor.
Global climate change has been the norm throughout geologic time. I am sure human activity is contributing, but an not sure to what extent, compared to normal, nonathropogenic change.
Global temperature change of this and greater magnitude have occrred in the past without human contributions.
Global temperature fluctuations are normal aspects of Earth and on larger variation scales than documented during human contribution. Hard to separate the normal fluctuation form human input over such a short time range.
Global temperatures have changed significantly over time in the geologic past and the extent to which present-day increases can be attributed to human activity has not been ascertained to my satisfaction. Certainly it was even warmer than it is now during the times of the Vikings, followed by the 'Little Ice Age', when the ice sheet advanced over Viking settlements in Greenland, which I doubt was named with tongue in cheek.
Gobal climate modelling is extremely complex and considering that our records are relatively limited, I don't feel we know exactly how much we are contributing to the general post-Pleistocene warming.
good possibility, but way too many variables to make concrete decision on magnitude of impact
Haven't seen good science that separated out naturally occuring from man made temp increase
Historical and pre-historical changes in climate were more significant than we are experiencing now.

historical records of fluctuating Earth temperatures; number of variables that control climate; lack of ability to predict the weather tomorrow let alone what will happen in the future; lack of confidence in climate models; experience in developing countries where the environment exerts a strong control on human activities and lives
How does one conclusively separate human activity from natural activity?
Huge number of variables, many not well understood, such as changes in solar output. Humans have certainly been a factor - but a significant factor? I'm not sure...
Human activity is almost certainly contributing to the problem, but the overall significance is uncertain. Temps were several degrees higher than today about 6-8000 yrs ago, then down during the middle of the last milennium, and now back up. On the broad scale, data from the past shows that we're due for a sharp downturn in temperature. However significant our contribution is, it is essential to curb our emissions of greenhouse gases because they represent consumption of energy that is being rapidly depleted.
Human activity likely is at least a secondary driver, but there is some evidence that solar activity may be the primary driver and that global temperature has been higher at times in the past.
Human activity may play a very small part but the non-linear ineractivity between cmplex systems amlifieds the effect or sets other larger factors off balance.
Human activity seems miniscule in terms of global climatic activity. Global warming/cooling has occurred repeatedly in Earth history whereas human activity is a factor only over a melinial timescale.
I am a glacial geologist with a long career of tracking natural change over the past million years and have worked ectensively on glaciers in northern Canada. Thos glaciers are, for the most part, retreating from their advance positions related to the 'little ice age' at which time they were as far advanced as in the last 8000 years, possibly in the last 50,000 to 60,000. Warming is obviously occuring, but the extent of the contribution of Humans is difficult to sort out, particularly with models that have little geoscience input.
I am not sure because global temperatures have under gone large fluctuations with out the input from humans so although I think humans may account for a part of global warming I am not sure humans account for all of it.
I am not sure we really understand all of the variables, natural and human , that are impacting global climatic fluctuations.
I am not sure yet what the effects of the sun are.
I am not unsure
I am not unsure, but rather, fairly confident that humanity is playing a large roll in climate change.
I am pretty sure it is but have not read far enough into the literature to separate all the sources contributing to global warming. The warm period preceed ing the litle ice age was significant, and our climb (in terms of T) out of the little ice age has been steep. I doubt human activity initiated the little ice age, thus there remains a good chance human activity did not end the little ice age. It looks as if increased, human-caused, CO2 is a measureable driving force but I have not read enough of the literature to be able to 'cite the smoking gun'.
I assume you mean 'substantial' rather than statistically 'significant.' I'm not sure how I would answer this if you meant statistically significant. Warmer global temperatures occurred during the hypsothermal when human populations and their influence on the environmental per capital were likely smaller Consequently, I am uncertain about how much of the change in the last 100-200 years are a result of human activity. It is possible that we have provided 5-10% of the change, but I am not sure if that is what you would define as 'substantial.'
I beleive that it is a factor. Its significance is debatable, and the science is all over the place as to whether human activities are the major contributor.
I believe human activity has played a role, but the question is the magnitude. That is, there are natural variations about which we have scant data, and current climate models have been tuned in part to replicate the climate record that is available.
I believe human activity is a contributing factor, it's the term 'significant' I'm unsure about.
I believe it is a contributing factor, but I am not sure how significant based on the data I've seen. Paleo climatology studies I've seen indicate hotter periods in the past for various locations etc. Bottom line is that on the geologic time scale it is hard to know exactly how much we are contributing to the warming. That said, I believe human activity has a large influence, I just don't know if available data can really tell us how much is human activity vs. natural warming period.
I believe there is insufficient data to draw conclusions in comparing between human effects and natural global cycles

I can accept that high CO2 levels do absorb more 300K-infrared re-radiated from the Earth's surface and so 'should' increase temperatures of the lower atmosphere, at least. Other effects, too, can produce increased temperature of the troposphere: slightly decreased albedo (lessened cloud cover and changing land use). This, too, could result from human activities -- land clearing for agriculture, for example. A more important question that we will deal with in the future is 'is increased global temperature a good or bad?'. We know that it would be a difference of condition from the recent past and that, as in the recent past (Vikings in Greenland), there are peoples and places that are disadvantaged while other peoples and places are advantaged. The Greenland and Vineland colonies are gone -- frozen out by the little ice age. Would the world be a better place for all if we were again in the little ice age? I rather doubt that. Adapting to changes is the way of social and biological evolution.
I do not believe all other contributing factors have been given enough attention.
I do not have information showing much the change in temperature excluding changes in land use, vegetation, etc.
I do not know the assumptions that have gone into the interpretation of data or the numerical models.
I do not know what you mean my significant. I believe humans are affecting the climate, I am not sure how and to what level.
I don' know how to distinguish the effect of human activity from other controls, and I don't know how you define 'significant'.
I don't believe that we understand the climate system well enough to make that determination definitively.
I don't think that definative case has been made as yet, but I'm waiting.
I don't think that I have heard all the data. I think there is significant evidence to say that earth has experienced drsatic climate changes prior to humans and our Hummers. But I don't beleive the data for those past drastic changes is at all as precise as what we've been able to gather with recent testing methods. It could be a sad but real coincidence that human happen to be on Earth spewing out carbon while the Earth would also be going through a normal warming trend.
I don't think we fully understand our own climate enough to conclude that human activity is causing the change. There were certainly warmer periods in the distant past (e.g. the Cretaceous) that were not influenced by humans.
I don't understand the question. I answered that I believe that human activity is a significant contributing factor, and the evidence lies in the systematic change in carbon isotopic ratios in the atmosphere.
I entered an answer I did not intend. I think human activity is a significant component, but I do not know if it is 10%, 25%, 50% or more.
I feel that the research is skewed. The research is funded almost exclusively to 'find evidence for' and 'causes of' global warming.
I have an interest in climate cycles. History is full of such cycles. Some were forced by large volcanic eruption like Krakatow (SP). But being a bit of a geologist we are aware that change has been normal throughout the millenia.
I have no data base to judge
I have no doubt human activity is a contributing factor and that we need to stop. The overall significance of our contribution to global temperature may never be fully assessable and I therefore believe we should stop simply because there is a chance we are a significant factor.
I have no doubt that it is a factor, and part of my answer relates to the vagueness of the word 'significantly'. Certainly natural variability is significant. I don't think we are yet able to ease out the fraction of warming that is anthropogenic from the fraction that is natural. If the anthropogenic factor is not yet 'significant', however one chooses to define that word, I have little doubt that we are moving toward a time when it will become significant.
I have not followed the research in this field.
I have not personally reviewed the data or any critical analyses of it. I do not trust consensus views and bandwagons as they are frequently wrong. It is irresponsible for a scientist to make a judgment without personally conducting a critical analysis of the data and the arguments.
I have not researched it enough to convince myself one way or the other.
I have nto seen all the data yet.
I haven't examined any data personally. I am aware that CO2 levels have risen, but I have not looked at mean temperature data.
I haven't personally done research in this area and there is a lot of conflicting published data on the subject. Also, from a geologic perspective, swings in the earth's climate have occured many times.
I haven't seen definitive evidence... just a lot of hand waving...

I haven't seen studies that compare human contributions to climate to natural changes.
I just don't think we have enough data yet to make that statement. The trend is compelling, but as a scientist, I remain skeptical. A trend may be related to some other factors that we have not yet fully considered.
I know that long-term fluctuations in temperature are driven by factors beyond human control, but I also recognize that anthropogenic activities have the potential to impact the long-term trends. I don't know where the balance lies.
I need more study on CO2 emission and generation data. I wonder also, if methane gas is a greater contributor to the greenhouse gases then we may think. Some of the studies I have read or presentations I have observed seem to have bias or perhaps unsettled objectivity. I am always a bit skeptical of 'popular science'.
I think human activity is a factor, I'm just not sure if it is a 'significant' factor. I think global warming would have occurred with or without human influence so I'm not sure if we can be considered 'significant'.
I think human activity is contribiting I am just not sure of how significant it is at this point.
I think it is a factor, but the question is HOW significant a factor? I find much disagreement among knowledgeable people on this question and it is obvious that anthropocentric blame for warming has become a mantra. I know that climate is a very complex, multivariate proposition, so am cautious about assessing the magnitude of 'our' contribution. That said, however, I have long argued that pumping various pollutants into the atmosphere is a bad thing and we should clean up our 'act' regardless of how much we contribute to warming; we know we contribute to general polluting of the atmosphere with various gases and particulates.
I think that human activity is a contributing factor--and even possibly a firts order factor But I would like to leave room for other 1st order sources
I think that the natural changes may be significantly larger than the anthropogenic changes. After all, look at the Ice Ages and early hot-cold cycles.
I think that the science that is being done by the climate people is poor quality.
I think the chances are likely that human activity is a contributing factor, but in the paleoclimate records we have also seen much larger fluctuations that appear to be a function of natural climate variability. The ice age is an example.
I think we may be jumping to conclusions and ignoring data that don't fit the current paradiam. Surely there have been warm periods in the past (Cretaceous, 1400s warming, etc.). I am not sure we understand what the natural range of variability is.
I would have to know what temperatures would be at this point under conditions devoid of human influence. This is difficult, if not impossible to know with certainty.
I would like to see data from ice cores from the last interglacial period concerning how quickly temperatures rose during that interglacial period. Since humans (if we truly even existed yet) were doing nothing that had any effect on climate at that time, then that might provide a reasonable rate of 'natural' temperature increase during an interglacial period, which could then be compared to the rate of increase of the current interglacial period to determine if the current rate of global warming is greater than 'natural' global warming during an interglacial period. In fact, it would be even better if we were able to obtain data from several previous interglacial periods, for it is possible that a single previous one might not provide a typical 'natural' temperature increase during an interglacial period.
If you look back in geologic time there have been significant temperature fluctuations we know are not human controlled/influenced.
I'm agnostic about the effects of human activity but have become more accepting to the solar cycle effects.Perhaps there is some human signal but I'm of the opinion that it is not the predominant cause.
I'm not sure that the temperature change over about the last 100 years isn't part of a natural cycle. Some paleoclimate data indicate similarly warm temperatures about 1000 years ago.
I'm rather sure it is! but as with almost all important questions, some uncertainty remains.
I'm sure it has some effect, but I don't know if its significant. I think cosmology probably has more to do with it than human activity.
I'm unsure about the nature of changes in global air temperature in the last 200 years.
In order to be sure we would need to perform an impossible experiment: suppress past human activity and observe the consequences. Human activity is very probable contributor to temperature rise.
In past geological history interglacial warming has been as dramatic or more so than the present.
In the geological past, there have been equally or more extreme climate changes due to natural causes.
Inability to test hypotheses in a proven scientific framework. The almost complete reliance on algorithms in computer models to relicate complex processes (some of which remain unknown) does not inspire confidence in drawing firm conclusions.

Information concerning temperature has only been collected in detail over the past 200 years. We could be experiencing a warming trend or warming due to human activity.
Insufficient data for certainty of linkage.
insufficient evidence
It appears that solar radiation varies in a manner that appears to correlate well with past temperature over the past couple centuries
It can be one factor, but not the sole factor. I have doubts in my mind about the weight of this factor in making the contribution to the over-all increase in temperature.
It certainly is a factor but until now the significance of human activity is mainly determined by models and there is not much evidence in terms of cause and effect relationship.s
It depends on your definition of 'significant. Is human activity a factor? Yes
It is clear that human activity has caused the release of huge volumes of sequestered, ancient carbon. But is is equally clear that climate is dynamic, and it is no easy task to 'prove' that our climate over the past 200 years is significantly different than it might have been in the absence of fossil fuel use.
It is hard to say whether the Earth would have naturally gotten warmer with or without the human activity. I have no doubt human activity contributes, but I wonder whether it is a SIGNIFICANT contribution or not.
It is not certain that all factors controlling climate are well known and understood. And, the models that have implicated human activity as a factor in climate change have many assumptions that may be found later to be incorrect or over simplified.
It is not that I'm unsure of human activity it's just that I'm unsure of the DEGREE to which human activity is the cause. My home is built on top of a coastal sand dune when sea level during the last interglacial (100K YBP)was 5 meters higher than today. That raises questions
It is reasonable to say that human activity is a factor, but given the tremendous changes in global temperatures through geologic time I cannot say how significant.
It is very difficult to separate human influence from natural variation on global temperatures, over the short time-scale that we have been monitoring. We are, however, significantly influencing the composition of the atmosphere, and impacting carbon and nitrogen budgets, which can contribute to warming.
It is well documented in the geologic record that global warming has increased and decreased well before the combustion of fossil fuel resources associated with human activity. Any discussion about man's impact on global warming has to address the global warming effects that occurred before industrialization of modern society, to do otherwise is scientifically irresponsible.
It seems pretty clear that human activity has influenced global temperature, but because the record of human influence on the climate is very short, I'm not sure we can call it a 'significant' contributing factor.
It would be very ignorant to think that the only think that impacts the world is humans.
Just because two variabls are correlated does not mean one is the cause of the other. Examination of climate data since before the Indusctiral Revolution does seem to show a compelling link between anthropogenic CO2 emissions and global mean temperature increase, but the longer-term geologic record reveals times of rapid climate change throughout the Pleistocene. Climate proxies from the even more distant past indicate that global climate is comparatively cool now, and that many factors besides greenhouse gases contribute to global climate change. When I hear ridiculous suggestions that we build satellites to block out solar radiation or pump CO2 into deep ocean sediments to try to combat anthropogenic global warming I am filled with irritation and trepidation at man's audacity - to assume we can fix a problem that might not exist, within a system we have only just begun to study. As a scientist I neither 'believe' nor 'disbelieve' in anthropogenic global warming - I am waiting for solid evidence. Mea
Lack of convincing information.
Lack of detailed studies pre-1800s. Uncertainty over the relative heating effects of anthropogenic versus non-anthropogenic processes.
Lack of hard evidence
Lack of information on previous climatic change
Long term changes in temperature (since 12,000 years ago; last glacial period) are substantial and short period variation in temperature is a complex signal. Deconvolution of contributors to the temperature increase will be very difficult to achieve with confidence.
Looking at Greenland during viking times it was warmer than later when the vikings had to leave - now it is warming once again -

Major fluctuations in global mean temperature have occurred long before humans arrival, and during that time was principally attributable to changes in the output of the sun.
Many factors are in play and it is a statistical thing. I think it is 'likely' that anthropogenic CO2 has contributed to warming, but is it the only contributor, or even a principal contributor? I'm not sure.
Many factors contribute to climate change. Although I find the data regarding warming to be very convincing, the relation with anthropogenic CO2 release is not as definitive, although the rate of change of temperature over the last 50 years is worrisome and if substantiated, is a strong argument that humans are contributing to warming.
May need longer term data....
Mean-annual temperature are starting to fall again without much change in human activity.
measured changes don't agree with models, much carbon dioxide is missing from inventory, our understanding of other factors is so poor that it's hard to estimate relevance of human activity.
Multiple factors of uncertainty. Specifically those related to long period (> 500 yr) changes driven by non-anthropogenic factors like ocean circulation and solar activity and the hydrologic cycle.
Multiple variants effect climate
My appreciation for and understanding of Earth's natural climate variability makes me ponder how much of the 20th century warming is human caused.
My familiarity with deep time and resultant reticence to draw any firm conclusions about causality in the context of systems as complex as the Earth System.
My understanding that temperature fluctuations occur on regular cycles and have since well before humans were around.
Natural climate variability is too complicated to separate, reliably, any consistent anthropogenic signal.
natural factors are still dominant.
Natural factors such as volcanic activity have been shown to have even more dramatic short term effects on global tempertures.
Natural fluctuations have occurred widely during the Pleistocene, and their effect today, as in the past, is likely to be so great as to partly mask contributions by man's activity
Natural fluctuations in global temperatures are larger than any proposed anthropogenic changes to date. It is certainly possible, but I'm not sure of it yet.
natural longterm climatic flucuations
Natural phenomena clearly can change global T (variations in sun, volcanic phenomena). I suspect human causes are operating, but magnitude relative to natural causes is uncertain.
Natural solar cycles may play a dominant roll. Human activity may aggravate the situation, but may not be the dominant factor.
Natural variability of the climate/solar system
Natural variability, incomplete understanding of natural forcing factors, and incomplete [detailed] records for a short time interval.
natural variation that occured in the past
Natural variations in global temperature can be large. The apparent increase in mean global temperature since the 1970's appears to be small, but significant. I am not convinced that this increase is caused by human activity, but it seems probable that it is.
Naural temperature cycles are clearly present, e.g. a long warming trend since the 'Little ICe Age' ca. 1500 and a short (ca. 10-yr) cooling trend in the 1970's. These are hard to distinguish from possible (probable) superposed anthropogenic effects.
need to see percent break down for all known contributing factors. Too easy to simply state humans as a signifcant cause out of context of all factors.
No control on what temperature changes would have occurred in the absence of human activity.
no homogeneous data sets for statistically significanrt time period
no solid scientific evidence
Not enough data or time to evaluate.
Not enough data to determine what the climate fluctuations have actually been over the last several hundred years and the causes of the fluctuation prior to the industrial revolution.

not enough evidence
not enough reliable data
Not sure if recent climate shifts are part of natural periodic changes.
Not yet enough time to know whether it ishuman-caused or part of some larger natural process.
ntaural variations (eg solar inlux) is a possibility too
Only indirect correlations are observable.
Other factors are obviously at play. I have no doubt that humans are influencing global temperatures, but whether we are a 'major' contributor is little more than guesswork.
Other factors could surprise us.
Other factors that are not fully accounted for that exceed the anthropogenically induced affects and not fully understanding the 'anticipated' coming ice age data that was the previous thinking in climate change
Other natural causes of warming are difficult to differentiate from anthropogenic causes. Earth has been warming for 10'000 y.
Our knowledge on the role of the sun and the oceans is too limited to attribute human activity as the main cause. The effects of natural variability and oscillations with periods greater than 50-100 years makes a single cause unlikely and quite frankly clime models, while important, are far too coarse in resolution and skill to identify causes.
Our planet's climate changes (fluctuates) with time, probably at varying rates over varying periods, and has done so for millions of years. This is normal. Attributing change to natural versus induced (artificial) influences is difficult. It is difficult to separate the two.
Our relatively poor understanding of other factors, such as atmospheric moisture levels, that may contribute to warming trend observations
past episodes of dramatic global warming have taken place and no humans were around to be the cause
Personally I have no doubt that human activity is a contributing factor to increased average MGT, but I cannot evaluate unquantified, qualitative statements like 'major,' 'important,' or 'significant' and disapprove of their use in scientific discussions/conclusions.
politics
Possible natural climatic changes? Changing solar activity? Perhaps a small contribution from human activities
Possible roles of water vapor and other nonCO2 greenhouse gases; relative role of CO2 increase and its context. (Note: saying I am 'unsure' as one of three offered choices is *not* intended as a pro-fossil-fuel apologia . . .)
Press reports--summaries of scientific studies
Primary factor is the warming that has occurred over the Holocene. Many debates seem to ignore this. Glaciers have been melting for the last 10ka.
Prior to anthropogenic CO2, atmospheric CO2 was climbing and at a level of about 300 ppm. So 80-90 ppm has been contributed since the 1800s. Therefore ~1/4 of the atmospheric CO2 could be from human activity The climate has been warming for 1000s of years with periodic cooling events. Climate will warm and cool without human activity. We do not completely understand the natural variations and cycles.
Prior to the Industrial Revolution, temperatures fluctuated during four major glaciations. We are still recovering from the last glaciation, and natural forces must still be at work.
relationship between atmospheric CO2 and global mean temperature
Science is based on scepticism and experimental proof. Whereas human GHG emissions certainly have a warming effect, the breakdown between natural and anthropogenic contributions to warming is poorly constrained. Remember that the warming since 1650 AD (not 1900) is part of a real 'millennial cycle' whose amplitude cannot yet be explained by any quantitative theory. Also, the computer climate models are both too complex to be readily understood and too simple to describe reality. Believing their results is an act of faith.
Science of CO2 relationship with warming is not clear

Several factors: 1) Lack of data/data accuracy on long-term temperature variability, in multiple regions, for time periods extending past the most recent 200 years. 2) Limited understanding of the complex interplay of multiple natural processes on climate change. 3) Fundimental distrust of complex computer models in accurately predicting future climate variability. This is related to the inaccuracy of data used in the codes and/or limited experimental data that goes into those models. 4) The Earth's overall climate has been experiencing a warming trend for the past 12,000 years. How much of the warming observed over the past 200 years can be attributed to this natural process vs. anthropogenic CO2 emissions?
Significant is a loaded term. Human activity has contributed to the increase in temperature, but how much has this activity impacted the global mean temperature? Additionally, how can one differentiate between human induced warming and the natural rise in temperature following the last glacial maximum? Ultimately, global mean temperatures have risen, with human activity being a likely contributor, but how much of the recorded increase is a direct result of anthropogenic CO2 is unknown.
'Significant' is a relative term. To me, significant means that most of the changing temperature would be attributable to human activity. I'm not sure that can be demonstrated.
'Significant' is a word that is open to multiple interpretations.
Significant is the key word. it has made a difference, but I am not sure if it is a significant difference or just adding to a natural change in temperatures
Significant record of large changes in global mean temperature in geologic record prior to evolution of hominids. The Eocene maximum was effectively +12C. The Cretaceous, and Carboniferous maxima may have been greater.
Similar changes in temperature have occurred in past history and the present causes are not yet clear to me. Furthermore, there has been no increase in global temperature the past 6 years, so there is a possibility that the peak has been reached and a decrease in temperature may be coming.
Since science is not a majority or democratic, the fact that a lot of people say it is caused by human behavior does not make it so. There is some evidance that is not explained adequatly at this time. We are at the end of glacial melting and most of the ice melting animal shifting etc can be explained by this mechanism. How much additional heating cause by human actions is debaitable.
Singer offers some interesting arguments suggesting that the cause of GW is primarily due to natural causes. The degree to which human activity may be involved is uncertain.
size of temperature change (still) within natural range of variability (for now) and correlations are contrived
Solar activity and other cycles could have contriubted to some of the temperature increase..
Some say we have it backwards. that rising temperatures are causing increases in CO2
spatial and temporal variation in data (e.g., hemisphere, seasonal, and time of day temperature variability); inability to control for factors
temp change is only a symptom: the cause of change is population growth
Temperatures have increased just as fast in the recent geologic past before humans had an impact.
Temperatures have risen and fallen large amounts well before humans were around to influence climate.
That the humans are a contributing factor is clear, as to 'significant' is debatable. I base that decision on the variable quality of our dataset and the relatively limited time coverage (e.g. relatively good data in the last 50 years, marginal or 'corrected' prior).
The atmosphere is a complex system and I am not sure we are accounting for all of the necessary feedbacks that would kick in from human activity. I believe human activity is likely doing something, but I hesitate to say it is 'significant'.
The 'bandwagon' effect that climate change has gone through, the politicization of much of the discussion, and the extreme positions taken by some on both sides in the controversy.
The complexity and natural variability of climate.
The complexity of the system being analyzed.
The data are not conclusive as to the role of different factors, such as solar output, CO2 emissions, ocean currents, etc. Also, the models are not good enough to incorporate all the aspects, such as ocean-atmosphere coupling.
The data is not clear
The definition of global mean temperature is biased by human intervention around the observing sites. The answer is also complicated by the difficulty in distinquishing trends from long cycles.

The Earth has and will always have severe climatic changes in some period of time. So what cause the iceage in years past and what cause it disappear? The human population wasn't as large as it is now. There is too many variables to consider.
The earth is 4.6 billion years old. We have only been here 4 mil and impacted the earth for 200 years. How can we be sure there aren't other factors?
The earth is constantly undergoing change, and I'm not satisfied that we understand the factors controlling climate well enough to say what is the major factor here. Are we still coming out of an ice age? CO2 is certainly not the most effective greenhouse gas, and that seems to be overlooked.
The Earth's climate is clearly subject to many controlling factors, both natural and anthropogenic, as we know that there have been many major changes in climate over geologic history not caused by humans. Over relatively short (in geological terms) time frames, and given our limited understanding, these are difficult to distinguish with complete certainty. While it seems highly likely to me that greenhouse gases are a factor in current warming (most likely the primary factor), I don't think that scientists should claim to be absolutely sure of that given the many uncertainties. Nevertheless, given the high likelihood that human activity is a major factor, and the high stakes involved, I think we must act under the assumption that it is.
The effects of solar radiation changes through time are not well understood, and have not factored into the models, as I see it.
The evidence is based on computer modeling more than on hard facts. The influence of the Sun is possibly large in view of the climate history in the recent geological past.
The experiment to isolate mankind's impact on the mean global temperature is impossible to conduct in a controlled setting. Instead, we are presented with correlative evidence, but not causative evidence.
The geologic history of temperature global temperature change.
The global climate system is very big and complicated. the mean temperature is only one measure of climate change. Humans do affect the environment, but are we a significant factor changing mean temperature?
The global temperature has always changed so I don't worry too much about the cause.
The globe has been warm before. Witness tropical plant fossils in far northern climates.
The greenhouse mechanism is plausible enough, but the models used for projections are unreliable. None has ever survived a proper scientific test with high quality data in quantity; few have even been tested at all. The ocean components of the coupled climate models have glaringly obvious and serious defects. The situation would be ludicrous if it were not so important, and may eventually redound to our possibly permanent discredit. A 'back of the envelope' calculation for CO2 and radiation in a uniform static atmosphere would have as much real scientific content as an unresolved computer model, and a dire warning from it would incline me to encourage governments to take action even though the case had not been made beyond a reasonable scientific doubt. But we should not be overselling the case as we presently are. I DO support the proposed 'greenhouse' policies since they will at worst err on the side of caution, and will certainly ameliorate soot, sulphuric acid, NOx etc and will conserve i
The key word here is 'Significant'. It seems to be well established that human activity has contributed to CO2 increase (and by implication global warming). What seems to be less well known is the effect of solar variability on the overall heat input to the earth, the CO2 uptake potential of the oceans and what a 'Normal' climate change perturbation is. (The younger Dryas for example) Without a doubt, if we keep moving in the direction we have been, we very well may prove out that we are a significant factor in global mean temperature. To say it is a certainty now implies a level of confidence in our understanding of earth and atmospheric processes that I am not sure we truly have. I would clarify, however, that I am answering this from a purely scientific standpoint. i.e. how confident am I in the state of our understanding as to the significance of the human input. From a sociological standpoint, I think we should all we can to try and reduce our footprint from pollution and population st
The key word is significant. There have been cyclic warm and cold periods since man has been on earth. The last 10 years the mean temperature has been rather flat, and we have a downward spike this winter. I'm not sure of all the factors going on. I mainly focus on short and medium range forecasting. I am eager to learn more about climate change.

The largest lever in mean global temperature is mid-level atmospheric cloud cover. The human contribution to greenhouse gases is obvious, but it is not obvious that it is the largest sensitivity. Cloud condensation nuclei formation may be a bigger factor.
The literature seems confusing and it's hard to separate opinion from fact.
The longer term history of global climate changes dating back into the Tertiary and earlier geologic time periods and eras. Human activity is affecting mean global temperature including the rates of change, but I'm unsure that it is a significant change in terms of the earth's history.
The magnitude of natural fluxes is poorly known.
The meaning of the word 'significant'. I am sure that humans have made some contribution; I am uncertain of its improtance. After all, there have been other periods of global worming, all before the industrial revolution.
The natural system is so complex that it is difficult to be sure of our impact. However I think it likely that we are having an impact.
The present data on this is not compelling
The present trend in temperature has components of natural and anthropogenic contributions. Neither component is well quantified. I suspect that the natural component is large. I suspet the human component is real, but its contribution to the present trend is uncertain in my mind.
The quality and length of observed data collection. I think there is a good chance (65%) that humans are affecting the global climate.
The question fails to distinguish between warming that is measureable today and predicteed warming. Warming observed SINCE 1800 is small and difficult to distinguish from natural fluctuations. I think there's an anthopogenic component visible today, but here is room for differing opinions. BUT: the basic mechanism of greenhouse warming is beyond reasonable doubt. Human activity can and will enhance that warming drastically unless greenhouse gas emissions are curtailed.
The question of how much input from the sun is important here has not yet been resolved, in my opinion.
The relationship between the temperature increase expected from coming out of the Little Ice Age, as well as the variations in both global mean temperature and mean temperatures at individual climate stations in the 20th century. On the other hand, the large number of very warm years since 1990, the increasing amount of CO2 in the atmosphere as a result of human activities, the effects of humans on decreasing planetary albedo and other factors all strongly point to human activity as a significant contributing factor. I lean in this direction, but wish I understood the spatial and temporal patterns of temperature since 1880 more clearly.
The rise has been too fast too sharp. I do not know if one can prove the connection, especially when there is evidence of other such temperature increases in the past, well before humans began burning fossil fuels.
The short time frame for instrumental records, the uncertainty and errors in instrumental records,the question of whether the urban heat island effect has been removed, and the potential for variations in the amount of solar energy reaching the earth.
The study of earth systems is not complete. Too little is known about the role oceans and solar activity play in the climate change scenario.
The techniques for determining a global 'average' temperature are open to question. Consequently, the actual amount of change is difficult to determine. This has to be considered in regard to: Since we are coming out of the 'little ice age' (I will note that Mann's 'hockey stick curve' has been demonstrated to be incorrect)it is difficult to know exactly what factors are driving the slow rise in temperature. The role of CO2 in respect to temperature is 'uncalibrated' - we do not know how the two respond to each other...except for the fact that ice cores (Vostok) clearly demonstrate that temperature rises for hunderds to perhaps a thousand years before CO2 levels rise at the end of a major glacial episode. So we do know that temperature controls the amount of CO2 in the atmosphere under normal conditions - no human influence. We are clearly in uncharted territory. In addition - at this time - we have lots of hypotheses and few ways of testing them in respect to numerous rapid changes in temperature that ca
The term significant is somewhat ambiguous particularly in comparison to climate changes ithroughout geologic history. I'm not certain if mean global temperatures would remain constaint even without any human activity. I do believe that human activity can contribute to global climate changes.
The uncertainty involved with accessing the magnitude of the impact of natural factors that influence climate.
The use of the word significant makes me unsure. I know that climate fluctuations are normal, and I'm not convinced that humans are making current temperature changes significantly different.
The variability in the historical record.

The warming curve is not a prefect match to the CO2 emission curve, Clearly other factors involved.
The way that you phrased the question implies that human activity has to be a significant contributor. I think that the data indicates we are contributors but I'm not sure that we understand the background cycles/changes well enough to know how small or how hughe our impacts are.
There are documented icehouse and greenhouse periods throughout Earth geologic history, so this may be an natural change in that cycle. Also, without a control (i.e. an Earth without anthropogenic greenhouse gas input), I don't believe we can say positively that human activity is having an affect. Actually we would need multiple controls and treatments to make a scientifically sound statement. Personally, I feel it's having an affect on global temperature, as I don't see how it could not have a affect. Even if it's not the sole source of global warming, it must exacerbate the change.
There are many natural causes of global climate change, and while humans may impact MEASURED temperatures through actions such as burning fossil fuels and urbanization, it is not clear that these play a SIGNIFICANT role in the climate change that we currently see.
there are more variables than equations...
There are natural fluctuations that occur in mean global temperature due to variations in solar output, terrestrial orbital variations, volcanism, and likely other factors. This is not to say that the rise in mean global temperature does not have an anthropogenic cause. However, it is not yet clear how much of the rise can be attributed to anthropogenic cause.
There are several natural phenomena that can contribute. I think human activity is a contributor but not the only contributor.
There are significant temperature fluxuations in the past geological record prior to human existance.
There are so many other factors influenceing global warming. I just saw two reports recently that document increases in the sun's insolation on the past 30 years. This is important that we consider all the possible influences before we draw conclusions.
There are so many variables other than human activity which have been causing much larger global climate change for 4.6 billion years and I do not have confidence that they are all understood well enough to eliminate them as causes for the increase in temperature seen lately and, therefore, to lay the cause at the feet of humans.
There are too many things we don't know about the Earth climate system. Although it is logical and may even be very likely that human activity has contributed to the increase of mean temeprature there are other processes that could also have contributed to this change. Many of those processes are unknown to us. Another reason is that the temperature increase has not been monotonic; there was a period of decrease of the mean temperature from late 1940s to late 1970s. If human activity has been influencing the mean temperaure why there was cooling in that period? Obviously other processes have been affecting the Earth climate.
There has always been climate variation and it is difficult to separate human from natural influences
There has been so much natural climate variability throughout Earth's history, and so much that we still don't understand about the complex interactions. I absolutely believe that humans are abusing their natural resources.
There has not been an adequate explanation of the causes for theLittle Ice Age and the Medieval Warm Period. We may still be coming out of the Little Ice Age.
There have been climatic cycles for thousands of years. Are we looking at a cycle?
There is ample evidence of significant temperature changes that have occurred before humans were a factor
There is certainly an anthropogenic contribution but I am not sure yet whether it is 'signifcant' (whatever that means) or not.
There is clearlky an ongoing rise in CO2 that is probably dominantly the result of human burning of fossil fuels and clearing of vegetated land; however, it may be that the CO2 is an indicator rather than a cause of the temperature rise. Climate is such a multifaceted phenomenon, that ther may be may additional natural causes for the temperature rise. SDo, I'm not sure of the relative significance of human activity versus other factors. I do however, think it prudent to behave as if we are the cause, and change our habits regarding use of fossil fuels and clearing of forests etc.
there is large variability on many time scales within the system.
there is no objective way to measure
there is no proven evidence
There is not enough known about possible alternatives to radiative forcing to be sure it is the dominant control. For example, buffering feedbacks related to clouds are likely important but poorly quantified.
There is not total agreement that human activity is sufficient to cause temperature rise. Other factors are significant as

well, maybe more so.
There seems to be ample evidence showing that temperatures are increasing on a global scale. There also seems to be significant data showing that certain green house gases have increased. However, filtering out natural variations from anthropogenic variations in such a complex system is not easy, particularly given the fact that many of the GCM's do not accurately characterize existing conditions. Thus, I do not believe that we have a thorough enough understanding of earth-sea-atmospheric processes to determine cause and effect.
These type of cycles have occurred numerous times throughour geologic time. Although human activity is an obvious factor, the effect of volcanic activity, for example, continues to be a significant factor as it has in the geologic past.
This is not a question that I have investigated in the primary literature.
This is not my area of expertise. Most of the hype is non-factual and difficult to analyze objectively.
throughout geologic time there have been many climatic changes that have had nothing to do with humans
Time frame for which we have analytical data.
Tmeperatures have flucuated over geological time
Too many complicating factors. We can not even be sure if CO2 levels are causing temperatures to rise, or if CO2 levels are rising in response to temperature rise.
too many factors besides human, to be absolutely sure.
Too much of the anthopogenic-origin crowd have jumped onto a religious-like bandwagon. Also, one must claim an anthropogenic cause in order to obtain funding. There really has not been a true, scientific debate.
too short a period of meaningful, accurate measuements
Using oxygen isotope ratios in deep ocean floor sediments as a proxy for global ocean temperatures demonstrates many distinct periods of warming and cooling during the last 200 million years. These natural global climate changes predate the industrial age. We need to understand the cause(s) of natural global climate change before we can confidently address the effects of mankind. Sure we make lots of CO2 and ice core data indicate CO2 concentrations rise with temperature, but does increasing CO2 force higher temperature or does higher temperature (perhaps from increased solar luminosity)force higher CO2 concentrations. Does 'significant' mean perceptible or outside the 'normal range' of observations. If you choose the latter, then compared to natural processes, peturbations to natural systems that can be attributed to mankind are probably too short term to be geologically significant.
Variations in solar energy; changes in ocean thermohaline circulation driven by changing atmospheric patterns
Variations over geologic time are much greater than what has happened in the last 200 years. There are many factors that affect global temperatures, and human activity is only one.
wait. I am sure that human activity is very important and perhaps dominant as the cause of climate change.
Warmer periods in history exist
We are in a natural global warming cycle (Milankovitch). Human activity (output of tons of CO2) has an impact on the planet. Enormous amounts of CO2 for example are turned into carbonic acid in the word's oceans, causing problems with ocean acidity in the near future. I just don't know how much of the humanly produced CO2 contributes to global warming, versus ocean absorption, versus other things we don't know about.
We are in an inter-glacial period. It has been warming since the last glacial advance.
We are looking at a complicated system affected by factors such as solar changes.
We do not understand these processes completely. We know that a couple of volcanic erutions will emit far more gases than we are producing, but no one is trying to see how much of the temperature change is due to volcanic activity. Furthermore, global warming is a natural process that occurs in cycles. We could be in one of those natural cycles. The rates of global warming may be different. Bassically we do not have enough evidence or understanding of the process to say human activity is the only factor causing global warming today--we haven't fully examined other factors. The world was hotter in geologic times--what cause it then? Our research should be focus not on the causes so much because we can not change that, but on the consequences. What can we do when the sealevel rises to protect so many cities that will be effected? What weather changes will we see. We will not stop global warming but we can prepare for it if we are smart.
We dont know enough about long term natural temperature changes

APPENDIX F (continued)

We know relatively very little about past climates to determine how changes in global systems affect the present climatic conditions. More research is needed to determine the background temperatures/conditions in order so that the contributions of human activity can be evaluated.
we need to observe over a longer time period
What caused the Medieval Warm Period? The Little ice age? Certainly not human activities. We do not know enough about the forcing factors of minor climatic cycles.
What defines significant? If 1-2 degrees F is considered significant then I would agree that human input is significant
what do you mean by significant? Statistically? A player in the total rise? sure we are! How much? I am not sure.
What is meant by significant? A major contribution, yes, but what is human activity compared with increased solar activity. So far, it is lost in the statistical models.
While it certainly seems likely that human activity is at least partly responsible, I am not aware of data conclusively proving this. It has been documented that natural earth temperature cycles occur with, or without, human-based effects.
While it seems likely that humans must be a contributing factor, I have seen no concrete evidence that the human factor is significant. Global warming trends correlate quite well with what one would expect from the convergence of many natural factors/cycles/rhythms operating on a number of scales and magnitudes. As an undergradute, my knowledge of these natural factors often made me think that we should expect a significant natural warming in my lifetime. Here it is. Is there a human factor? Most probably, but I am still searching for a good example of this factor and its scale and magnitude(based on good science).
While the production of gases such as carbon dioxide from human activities is certainly occuring, our data are limited to a relatively brief period in geological and climatological terms. It is not clear to me that all or most of the temperature changes can be attributed to human activities, or even is the temperature changes are outside of geological norms.
Who am I to judge? The evidence is via correlation not fact.
Who said I was - this is gettting loopy!
Your use of the word 'significant'. It seems clear that human activity has caused an increase in CO2 levels. That, in theory, might have caused an increase in global temperature. However, did it? If so, was it the only cause? If it was a cause, was it a significant cause?

Emails Received

**italics denote reply*

I am on the team. Your survey is most appropriate and I am honoured to have been asked to participate.

Tried, but could not use the provided selection of answers to the 2nd question,
"Do you think human activity is a significant contributing factor in changing mean global temperature?"
The answer is "probably" or "Very Probable". That's neither "yes", "no", nor "I'm not sure". I am sure that human impact is very probable. Anyone who is "sure" of either "yes" or "no" is either ignorant or fibbing. "I'm not sure" is equivalent if I know nothing whatsoever or if I know a lot.

I'd be happy to participate. This is a great idea. We were talking about this just yesterday and I'm guessing you'll find less consensus that the media tend to suggest.

Thanks for doing your survey. I hope your results shed some new light on this important question. However I would like to amend my responses because I am disturbed about the scientific community's response to global warming.
As I indicated in my survey responses, every scientist I work with is convinced that human activity is a factor influencing global warming, but it is also well known that the causes extend beyond human activity to include astronomical cycles which we had no part in creating and which we are powerless to stop. I have not found anyone who could tell me what percentage of the warming we've seen so far is attributable to natural vs. human causes, however.
I feel that the scientific community has not been totally forthcoming in public statements about acknowledging the dual causes of global warming, and that someday people will realize that no matter what we do, we will never stop global warming entirely because a good fraction of the causes are natural and not anthropogenic. I'm afraid that at that point people will feel misled by scientists and politicians who have implied, essentially, that "we caused it, by cleaning up our act we can stop it." I feel that this is a recipe for public disillusionment with the science community, and is a mistake on our part.

With all the spam, I think you should let people know how you got to the people that you are asking. We're all wary about these requests…

OK Maggie, now what?
Please direct.
I only obey one principle, delicious passivity.
Tell me what to do, and I will do it.

It is easy to point at the apparent correlation between carbon dioxide and global temperature rise and blame man.. I believe that there are significant human inputs. The most directly measurable is the change in albedo by transforming vegetation to concrete, asphalt, and shingles. The heat

island effect is real and cities are dumping megakilocalories into the atmosphere daily. The question is how does the atmosphere respond to the addition of heat at near ground level?

Dear Ms. Zimmerman: I began to participate in your study, but found that it is styled as an opinion poll, i.e., what do we "think". Also, it asks for "global" values. These factors throw biases into the study from the start. Rather than what I may "think", I prefer to depend on data and resulting information to reach conclusions. Further "global" averages are deceptive. Some areas are clearly warming at alarming rates, particularly in polar regions, and the human footprint seems justified by scientific analysis. Other areas may be cooling.
Please redesign your study, even if it would take longer for responders.

**Thank you very much for your comments. In designing the survey, we attempted to create language that was as unbiased as possible, though in a survey of this nature that is inherently difficult. The first question you brought up was originally worded to ask what geoscientists "believed", but was later changed to think in an effort to stay true to the purpose of the survey, which is to assess the opinions of geoscientists. I imagine that geoscientists use many avenues to inform their opinions, the most prominent of which is likely data, but I wanted to be sure that the question didn't ask specifically for what geoscientists believed based only on data, because as I said, they may use many means to inform their opinions. You comments point out the trickier part of wording a survey, and I will be sure to make note of that when I am processing my data and interpreting my results.*
Again, I really appreciate you input.

Maggie: Points well taken. "Believe", of course, is even worse.
Good luck

Good Luck on your study.
I wanted to suggest some different kinds of information that would be helpful to have, because it would get you closer to the process by which scientific opinion grows and develops. For example it would be interesting to know how many years ago an individual investigator realized from his/her own data that the warming trend was outside the bounds of what is seen in earth history. Also, whether he/she was convinced of climate change by the literature before he/she saw the evidence in her/his own data. Also, is the investigator connected to the oil-gas industry or the automobile industry, or a political party in a way that would suggest a potential conflict of interest.

It would also be interesting to have some indication of the very broad range of data that climate scientists are gathering. For example my students and I gather data in the form of temperature-sensitive isotopic ratios of calcium in the growth rings of fish ear stones “otoliths” from ancient deposits and from middens of prehistoric past to assess whether the climate was warmer and whether the higher temperatures were primarily in the winter or the summer or both or neither. We also study the local extinction of coldwater fishes and the northward spread of southern, warmwater fishes. We also study whether the increase in temperature is seen earlier around urban centers. All of these observations convinced us, gradually, in the late 1980s even though we were originally skeptical in the early 1980s. It would be interesting to know, in other words, when people saw evidence in their own data and when they were finally convinced by other people’s data.

I will be happy to respond.
BOTTOM LINE!!! Global Warming is real.
However, geologically there have been at least seven
periods over the last 2 million years when ALL terrestrial

ice has melted raising sealevel 100 m. no big deal.
Industrial revolution is accelerating the process a tiny bit.

I can't see why we didn't have the choice of zero for number of papers on climate change.

There was a question early in the survey about present temperatures vs. those before 1800 (if I recall correctly). I took this to mean "during the most recent climate cycle." Even higher temperatures probably prevailed at various times prior to 20,000 years ago. They were surely not driven by anthropogenic factors but that doesn't mean that human activity is not the present driver. For more than a few earth scientists, the wording of the question may be a bit too ambiguous.

I took your survey, but due to a slip of the mouse and
inability to back up, my first answer was misreported.
I do believe that the earth has warmed since 1850.

I filled out the survey. I for one have very serious doubts that the correlation between CO2 levels (manmade or otherwise) and global temperature, as it's currently being touted, is correct.
The first question on the survey, though, is a problem. I'm a geologist, so "before 1800" doesn't mean much to me because I know T has varied over time, so WHEN exactly do you mean? 1799? the middle ages? The thousand years prior to 1800? The last million years? Throughout all of earth history?

**Thank you for your comments. In that question, my intent was to ask about temperatures prior to the industrial revolution, which does imply that the advent of industry, and CO2 output increases, would do something to change the temperatures. It is helpful to have you point out that those who doubt the CO2 and temp correlation may have issues with the wording. I will be sure to keep that in mind when I am processing my survey results.*
A main goal of mine in this survey is explore the different ideas that are out there and get a feel for why geoscientists believe what they do. If I may ask, could you elaborate on the source of your doubts about the CO2/temp correlation? Many thanks for your participation and your comments!

I'm not going to dig back to primary sources, so do not quote me on any of this, but I can say there are several issues:
1) CO2 in earth history has been at least 10 times higher than at present, but temperature was not radically higher than it is now.
2) There's research that suggests there's a limit to how much CO2 can affect T, i.e., an upper limit, so the relationship clearly isn't linear, as has been implied by many people.
3) There are few that would argue that there's been an uptick in T, but I can easily see that the error bars on that uptick are relatively large, and therefore any correlation to CO2 concentration has to have that error propagated--which I doubt is done.
4) The "hockey stick" graph that the IPCC so touted has, it is my understanding, been debunked as junk science. While they've never admitted this to be so, it's my understanding that the graph has disappeared from IPCC publications. Therefore, any suggestion of a causation between increased CO2 and increased T is debunked.
5) Although it's a short time frame, I've seen graphs that show CO2 and T to be

diverging over the last 10 years or so.
6) Plots of CO2 versus T in the last 600 million years show little correlation between the two parameters. To now claim that there's an direct and precise correlation would appear, based on that fact, to be arguing a special case in the extreme.
7) There's ice core research to indicate that T drives CO2 concentrations (pre-human influence) and not the other way around.
8) I'm aware of the huge error bars in various input parameters in the climate models. To still use those models and to claim to be able to precisely predict what will actually happen is highly suspicious.
9) GCMs run backwards into the 20th century fail to "predict" the T changes therein.

I may be mixing several issues with the foregoing, so let me try to clarify...
1) Is CO2 a greenhouse gas and can its concentration theoretically affect global T? Of course.
2) Has it, in any simple way, controlled earth's T over geological time? It appears it has NOT, and there appears to be evidence that T has controlled CO2.
3) T has increased a small amount in the last 100 years, and CO2 levels have risen owing to the burning of fossil fuels. But has the burning of fossil fuels CAUSED the T increase? I don't believe we yet know, because correlation is not causation! Furthermore, at least some people think T was in the process of (on average) increasing anyway, and some people would argue this has been the case for around 300 years, so we're in a lousy "experiment". So, I do not question that higher CO2 can affect global temperature, and acknowledge that humans may be capable of affecting the climate. But I am not (yet) convinced that that this is what's happening now. If global temperatures were higher than those of the medevial warm period, I'd be more likely to be convinced.
I also think there's a huge bandwagon effect going on.
Two days ago I surveyed my class of 200 students and 60% said they believed the U.S. is in a recession (about 20% said no and 20% said maybe/they didn't know). Of course, the U.S. is not in a recession because a recession exists after 2 quarters of negative growth, and the fourth quarter of last year had slow but positive growth, and the 1st quarter numbers haven't been released--but we're definitely not (at least, yet) in a recession. So 60% of my class was wrong, or you could say that 75% of the students who had an opinion were wrong.

**Thank you for your response! I will not quote anyone who I correspond with by name, even if I refer to specific comments, I will most certainly maintain the anonymity of my respondents. You bring up many interesting points and I am thankful that you have shared them with me! May I contact you in the future if I have follow-up questions?*

Sure, that's fine. I didn't even bring up the political issues in all of this--not necessarily ones that would shape one's opinion on whether or not CO2 is intimately linked to T change, but ones that, when from the proper perspective, allow one to filter/ignore much of the noise associated with the issue (Al Gore, environmental extremists, and various politicians), and demonstrate the agendas and bias that's out there--things that scientists take as signs of questionable science.

Some questions before I complete the survey:

1. What is your working hypothesis(es)?

2. In what research context will the survey be placed? (What is the

title of your thesis? Is your thesis in Earth Sciences?, Earth Sci

Education?)

3. In addition to forming part of your Master's thesis, how else might

you envision the information being utilized?

4. How did you choose me? (i.e., how did you generate your list of

people to contact RE: the survey?)

Thank you for your time to answer these questions. I will complete the survey after I receive your reply.

**It is nice to get emails from people who take the time to check the legitimacy of this project and make sure they know what they are getting into! To answer your questions:*
1. The purpose of this survey is to assess the opinions of geoscientists on climate change, the scientific consensus on climate change, and what informs their beliefs. 2. My thesis is in an Earth and Environmental Science, but I also have a background in Environmental studies, which takes a more social approach to environmental issues. The title of my thesis is : Finding the consensus on the consensus: Using survey techniques to asses the opinions of geoscientists on global climate change. Beyond the simple results of who does and doesn't think what, I am hoping to gain insight into what goes into developing those opinions. 3. In theory, we hope to publish a short article on the survey results at some point in the future.
4. I chose you as a participant because you are faculty of a geoscience department. My email list was created using a directory of geoscience departments.
I hope this has helped answers your questions. Please let me know if I can answer any more!

I'm sure you have a specific experimental design that your question is supposed to answer, but it seems that by asking one question you don't have any statistical significance, other than to answer what percentage of people think humans influence global warming. I would think that you would want to also include other aspects of global warming and find what the consensus is with regard to what is the dominant factor in controlling global warming. If you are doing a TV poll, your approach seems adequate but popularity polls aren't very scientific.
You state, "The purpose of this study is to collect information on the opinions and attitudes of geoscientists regarding global climate change and the existence of a scientific consensus on the issue."
However, you only ask about human involvement in global warming and you don't specify if the scientists believe that it is a dominant factor, you only ask if it is a contributing factor. This leaves you with a conclusion that either they believe or don't believe humans contribute to global warming. you do ask about temperatures pre 1800's but in the geologic time scale you are comparing millions of years to the last thousand. This makes a lopsided comparison because we know global temperatures were alot hotter than current states with in the last million or even billion of years.
In my opinion humans can influence climate change but is it the dominant effect, absolutely not. The geologic time scale shows periods of cooling and heating with out the impact of humans being present.
I am not attacking your study, you may be answering the question you want, but I would advise you to follow your experimental design and devise questions that allow scientist to demonstrate their opinion on the subject of global warming. A simple question of what do you think is the cause of climate change: Humans, Sun, Volcanic ativity, meteor impact,... other. Or rank these factors of climate change in order of importance (same factors above with additionally proved scientific

methods), would allow for a more thorough scientific approach and answer the question you stated in the introduction to your study.
Sorry, if I seem to be ripping your survey. I just like to be thorough and have had significant training in experimental design so I get a little worked up when I see experiments that are not designed to answer the question that people pose.
If you have additional information to qualify your experiment to the hypothesis you are seeking I would like to review it.

**Thank you for participation and your thoughtful email. The primary objective of this study is to assess the opinions of geoscientists and assess the reality of scientific consensus on the issue of global warming. As such, I attempted to boil the questions down to a bare minimum, in order to create the shortest survey possible that still got at the questions I wanted answered (I realize that an academic's time is always at a premium and wanted to consume as little of it as possible). In order to ask questions about the varying dominance of human activity, I would have had to use a valuation scale, which I was trying to stay away from. The first question (warming since 1800) does refer to recent climate changes. I realize that the question leaves room for ambiguity about the time scale in question, and will certainly keep that in mind as I process my data and interpret the survey results.*
I very much appreciate your comments, they help me reflect on the different ways respondents can read the questions and the different issues that are likely to arise.

In looking at the first question of your survey - what do you mean by the "mean temperature" pre-1800? Is this over all Earth history? Or is this in the past 1000, 2000, 10000, 1Myr year? I think that this affect my answer.

I find your some of your questions confusing.

"When compared with pre-1800's levels, do you think that mean global temperatures have generally risen, fallen, or remained relatively constant?"

This appears to be a misleading or at least a very imprecise question. For example, what do you meag by mean global temperatures? Are you asking about mean global atmosphere temperatures? Mean global sea+atmosphere temperatures, etc.? Second, what is considered "pre-1800's levels"? Do you mean from 4.6 billion ybp to 1800 A.D.? What time scale is considered pre-1800's?

"Do you think human activity is a significant contributing factor in changing mean global temperature?"

Once again, I find this imprecise and impossible to answer. For example, what level of significance do you mean? If something is unstable or metastable, it may take only a small push (and thus a small contribution) to push the process one direction or another. It this process tips, the contributing factor may seem to be relatively small but may have a large resulting impact.

I found it impossible to complete your questionnaire due to these problems.

Your first question is a poor one.

Temperatures have had an overall positive trend since the Little Ice Age of 350 years ago. There have been shorter cycles (approximately 32 years) of warming and cooling superimposed on that trend. Temperatures now are cooler than 800 years ago and cooler than 5000 years ago. So temperature trends largely depend on the starting and ending points.

You have some poorly worded questions in your survey that will result in ambiguous results. For example, on the first question, you ask about pre-1800 temperatures. Presumably you're refering to

the time period immediately prior (e.g., 1500 - 1800 a.d.), but many in your audience think in much longer terms. There were periods in geological time that were much hotter. On your third question, you mix terms dealing with *evidence* of global climate change with *causality*. These are distinct, and must be treated separately.

I strongly encourage you to have someone review your questionaire for other such issues.

I did complete your survey. However, no matter how important, no matter how apparently obvious the combination of facts and theory, scientific issues cannot be decided by a vote of scientists. A consensus is not, at any given time, a good predictor of where the truth actually resides.

Climate change is obvious in the glacial record, in longer-term geological data, in recent thermometry, in shifting distributions of organisms, in ice melt (Greenland, Antarctica, continental glaciers), etc. There have been other temperature changes in the geologically recent past: the medieval warm period, the little ice age, gradual warming in the 1800's. Quite clearly the CO2 and methane (etc.) effects from human activities are not all that is affecting the current warming trend (crisis), but the basic physics of global radiation balance and the role of 'greenhouse' gases says human activity is having (or will almost immediately have) enormous effects. The electrification of China using coal is by itself an experiment of huge and frightening importance.

Whatever your survey shows, keep in mind that the things we should be doing to protect worldwide environments are the same, whether or not anthropogenic greenhouse gas increases are causing the observed (indisputable) recent temperature rise. We need to reduce energy use in every sector. We need to shift energy production and transfer to non-carbon sources and fuels (including away from biofuels) in a massive way. It can be done and is an economic opportunity. This would protect us and societies everywhere from further stupidities of the insane magnitude of the Iraq war. We need to take population growth to zero, below zero and immediately. The human stress on every other living being and ecosystem is already unsustainable, and a radically altered future awaits the global society if this is not accomplished. The Chinese (again) lead the way in population control, at least.

And on and on.

The wording of the first question is a bit obtuse. I assumed that by pre-1880 you were referring to the early 1800s an not deep geologic time like the Cretaceous. I think that most will get the sense of what you were getting at, but there is a lot of the Earth's history that is pre-1880.
Good luck with the survey.

I participated in your online survey. I would like to take a few minutes to give my views of the Global Warming topic.

If the earth is in a warming period, I think it is part of the normal fluctuations of the earth. There were several ice ages and warming periods prior to man's appearance on the earth. So obviously man did not cause them.

I do not believe the human race has the power to raise the temperature of the earth. I believe this global warming scare is a hoax designed to raise taxes and fill the pockets of the likes of Gore and those who do research in the topic, etc. I am not the only one who feels this way. One of our professors, XX, paleontologist, Antarctic specialist, agrees with me. He said he is treated like a pariah here at XX. Remember the ozone depletion scare about 10-15 years ago? It has now been determined to be normal fluctuations.

S. Fred Singer has an excellent website: http://www.sepp.org/

Also, Roy Spencer came out with a new book this month: Climate confusion : how global warming hysteria leads to bad science, pandering politicians, and hurts the poor / by Roy W. Spencer. John Coleman, who started the Weather Channel, does not believe in global warming either. http://newsbusters.org/blogs/noel-sheppard/2008/03/04/weather-channel-founder-sue-al-gore-expose-global-warming-fraud

Funny we do not hear about this winter showing the huge drop in temps that wiped out a century of warming:
http://www.dailytech.com/Temperature+Monitors+Report+Worldwide+Global+Cooling/article10866.htm

Needless to say, I keep my opinions to myself around here pretty much. But I DO order books presenting the other side of the argument.

Thanks for letting me bend your ear.

I responded to your survey. However without defining what is meant by significant, you may get a wide range of responses that agree. I personally believe that humans are influencing climate, that they augment change, and that climate will continue to change irregardless of what humans do.
I study glaciers. Earth has had hundreds of continental scale glacier events during its history. Glaciers will continue to experience cycles where they expand and then contract, and then expand again, as they have done many times before, prior to humans evolving. They will also continue to do so long after our species is extinct.

Because some internet spam comes disguised as a survey or similar, and because your topic can be controversial and I don't wish to play into unethical hands, I am wary. You may encounter this problem with others in your survey. I will happily proceed with your survey if you can have your advising professor e-mail me with verification that your project is legitimate. I apologize for the hassle, particularly if you are on sound ethical grounds.

I just did your survey on global warming and I just wanted to make a couple of comments as follows:

1. I believe in global warming, both short term (my lifetime) and long term (10,000 years). I also believe in cycles and that someday we will see cooling.

2. I believe that global warming is caused, to at least some degree, by human activity.

3. I am not absolutely convinced, however, that carbon dioxide is the culprit. I think that remains to be proved. Carbon dioxide is complicated, and I believe that there could be other both human induced and natural causes for global warming.

Cheers, Good Luck with the Survey.

Your first question does not state which period of time you want us to compare with pre-1800 levels (nor do you state which pre-1800 level you want us to compare with). This renders your first question invalid.

There are additional questions that I think you should be asking:

1. Do you believe the computer models yield estimates that are statistically sound?
2. Do you think it is the anecdotal evidence or geochemical evidence that better supports your opinion about global warming?
3. Do you believe the IPCC report accurately reflects the scientific standards set for causality (95%

confidence)?
4. Do you think it is appropriate to use paleoclimate data to forecast future climate change?

I have just started your survey. I have not gone beyond Q-1 yet.

Q-1: "When compared with pre-1800's levels, do you think that mean global temperatures have generally risen, fallen, or remained relatively constant?"

Here's my question. Was this designed to be ambiguous with respect to time? What do you mean "pre-1800s?" You mean compared to all Earth history prior to industrialization? If you are asking geoscientists then you really need to be more specific. Obviously global Earth temperatures are colder now than much of Earth history, but warmer compared to Little Ice Age temperatures. Surveys with imprecise questions have meaningless results.

Sorry for being negative toward your study. I do wish you success.

I'm afraid that your very first question was already ill-posed since it left open what pre 1800's means. After all, most of the preceding 4.5 billion years of earth history was warmer than the present.

I'm afraid I have to bail out of your survey. I find the issue too complex for multiple choice answers. As an example, Question 1 (comparing current global temps to "pre-1800" levels) is open-ended - and my answer would differ depending on the beginning as well as the ending point of the time frame. Are we talking about only the 18th century (which, of course, included the Little Ice Age)? The 14th through the 18th? Pre-1800 through the beginning of the Wisconsin Glaciation? Or since Pre-Cambrian time? On the average, current global temperatures are definitely cooler than the average over the entire lifespan of the earth.
Thanks for the opportunity anyway.

**I appreciate your attempt. I realize that, especially with an issue like climate change, many scientists do not feel they can express their opinions through simple yes or no answers because of the complexity of the issue. I will certainly make note of your comment on the ambiguity of the time scale in question in question one, and will keep it in mind when I am interpreting answers to that question.*

First I know that in US the use is different but Europe can commonly use the family name first. ;) I agree that it can appear confusing. No problem for the test. I find your project interesting, please let me know of the results of your work. Second; I am relatively interested in the subject, and I just wonder from who you got my e-mail address. I also have the feeling to know your name but my memory is apparently betraying me.

The first question on this survey was confusing. I presume you were asking about historic time and temperature averages on an anual or decadal scale versus the average temperature for the Cenozoic versus the average of 1700 to present?

The first question is unclear regarding the comparison to pre-1800 conditions. What period more recently (1800 - now, the start of the industrial revolution, since WWII?) are we comparing to what

part of the last 4.5 billion years of Earth history?
I did not continue the questionaire, but would be glad to if this question is clarified.

**The wording on this question has proved trickier than I imagined. I would like you to compare temps in the historical time period before 1800 (so, say that 1700's) to current temperatures. I hope that clarifies the question for you.*

What do you mean by current? This year, decade, century?
The last wrinkle is that I entered an answer to question 1 before I realized how much it confused me. Will I be able to re-enter the questionaire, change my answer to questions 1 and proceed? I am sorry to cause this trouble!

**By current, I mean temperatures over the last few years. I'm sorry that the wording made it troublesome to respond. While I can't back track the survey for you, I can make note of what answer you WOULD have answers #1 with. Again, many apologies that I cannot be more flexible on this, I built it certain safety feature when I designed the survey to insure against, among other things, ballot-box stuffing, so the system will not accept more than one survey attempt from each participant.*
Thanks again for your time and please let me know if I can answer anymore questions for you!

I am sorry to have been so troublesome. I didn't finish answering the survey, so the other questions are blank (and I don't know what they were). The answer to the first is that since the 16th century includes the little ice age, conditions now are distinctly warmer. They are warmer than even the Medieval Warm Period.
Furthermore, in addition to the large positive temperature anomaly, the rate of warming is so precipitous that I suspect that it is driven by human release of greenhouse gases into the atmosphere.

Was that a trick question, asking about climate change over the past 150 years and then seeing if we thought it was related to Milankovitch forcing?

**Thanks for your email. It certainly wasn't meant to be a trick question! I listed Milakovitch cycles as an example of what I meant by natural climate cycles - the time scale would indeed be inappropriate for the last 150 years of climate change. Good eye!*

Right-oh Maggie, but some folks you may have sent the survey to will, like me, take the question in the unintended way and dismiss it!
Good luck with your survey, although perhaps you might want to beef it up. It was quite brief for the subject. Indeed, at this very moment I am reading a fine and cogent speech on climate change given recently to the Planning Institute of Australia.

I am interested in your survey but before I take it I would like to know more about who you are and what your funding sources are for this survey. Are you supported by either environmental groups or the fossil fuel industry? How objective is your survey and how do I confirm that?

I participated in your survey, but the phrasing of one of your questions bothered me enough, that I felt the need to write to you.

You have a statement somewhere in the survey that you are assessing the validity of the statement "a concensus of scientists." This is an allusion to the 1995 IPCC assessment report statement in the summary presented to Congress that is phrased "a concensus of **climate scientists**."

Placing 'climate' in front of 'scientist' is an important distinction. You sent this survey to me, and I am a geologist. Geologists, and for that matter most other types of scientists, are not required to have education in atmospheric science to obtain their degrees. This means that although we are scientists, many of us are not really educationally qualified to make policy statements on the science of climate change. In fact, this type of 'definition' of scientist, i.e. deleting the adjective 'climate', has been a popular tool of deception with the gas and oil industry.

For example, after the 2nd IPPC assessment report was published, the gas and oil industry had a petition on which they claimed to have ten thousand signatures from scientists who disagreed with the IPCC assessment of a concensus. At the time I was working for Dr. Gerald Stokes, former director for the Joint Global Change Research Institute in MD. This was several years ago, and we were both at Pacific Northwest National Laboratory in the environmental research division. Part of my job as an intern for Dr. Stokes was to look at the misinformation circulating about climate change, including just who these scientists on the list were. A good number of them were geologists; several I recognized as petroleum geologists.

If you are trying to really test the veracity of the IPCC claim, which was more recently repeated in the movie *An Inconvenient Truth*, then you need to test the same target population------climate scientists. Otherwise, it is my belief that you need to rephrase your study in terms of your goals. There has never been an officially published statement, to my knowledge, that there is a 'concensus of scientists.' In the interest of avoiding a misleading statistical conclusion, I believe you need to rephrase your study to reflect what indeed was said by IPCC, e.g.

"The purpose of this study is to collect information on the opinions and attitudes of geoscientists regarding global climate change and the existence of a consensus climate scientists on the issue."

In addition, I also meant to tell you that on a postive note, I think this is a good idea for a MS thesis, and your web survey is pretty spiffy!

In your quest, please don't forget the fundamental difference between an opinion and a scientific conclusion. When you read an article the begins with the line, "Scientists believe…", there should be warning bells going off in your head. In the sciences we make inferences, we deduce and we build conclusions based on empirical observations. Belief structures are important and valid systems of thought and feelings…they are absolutely essential to our lives, but they are not to be confused or mixed with valid science.

Good luck with interpreting your results and remember, everybody is entitled to have their opinion heard but only those practicing in a discipline (e.g. science, medicine, law) can render well reasoned and sound conclusions. And the two families of communications cannot be compared equally.

Found your survey to be incredibly biased and almost meaningless

** Thank you for your participation. I am sorry that you found the survey biased and meaningless. Would you be willing to share with me how you came to those conclusions? In my quest to understand how my survey is interpreted, it*

is very helpful not only to hear from people who liked it, but from those you really didn't. It helps inform my own interpretations of the results, and any future survey design.

Your single question about today's temps compared to pre-1800s would include periods of "the little ice age" from the 1300-1800 and the warm period from 1000-1300 come to mind; also 120,000 years ago it was warmer than today as well as possible 8,000 years ago. So how could I answer this survey. I felt the question was designed to "confirm" the politically correct answer of "yes, it is getting warmer today", which does not explain why this year is so cold in the US and why the ice caps are continuing to shrink on Mars (relatively speaking).
I know that it is tough trying to do a very short question survey. But good luck with your survey.

I would love to hlp with your survey but the questions asked are ambiguous (, i.e. prior to the 1800s = the Cenozoic, the Mesozoic, the Archean etc..?) and do allow for a precise answer.

Personally, I think we are returning to something akin to the Little Optimum (climate regime of circa 950-1350)

What temperature do you mean? Sea surface?

I just filled out your survey. One brief comment. The first question is extremely difficult to answer in a non-pejorative way. Global temperatures before 1800 were highly variable but could not be accurately recorded, the Vikings made it to Greenland because of very warm temperatures at around 1000 AD.

As such, I had a very hard time answering the first question as time was not placed in context. Do I believe that the rate of change in global temperature in the past 40- years is instrumentally unprecedented …yes! Is human actively associated with this…most likely. Are we polluting…most certainly!!!

I am disturbed by that first question as I very strongly believe that the response that you get will in no way reflect the complexity of how geoscientists view this issue. What I have done is save screen captures of the survey so that it can be discussed amongst my collegues.

Thanks for the reminder. This AM I knew that there had been some request of this sort but couldn't even remember when I received it. If you are willing and have the time to respond, please let me know how you found my name and how many responses you hope to get. And, if you have the time, I could "pontificate" a bit about my experiences with this issue.

**I graciously accept all the pontificating you have to offer. It is very helpful for me to hear more from respondents than a multiple choice survey can provide. I got your name from a faculty index in a directory of geoscience departments. I sent out the survey to a little over 10,000 geoscientists, and was hoping for a 10% response rate. I already have over 2000, so so far, so good.*

Congrats on the response. I hope that the response is not skewed in either direction (probably more toward the Human induced global warming side in my opinion).
"Pont" 1. I am involved with how landscapes (e.g., the greater Chicago Metro area and surrounding areas) change, how they might change, and the impacts that the likely alternatives might have on

societal values. When we hold stakeholder fora or use questionnaires to elicit stakeholder opinions, we find that the repsonses are heavily skewed away from a development point of view. We NEVER say that growth/development is bad but we gather that the perception on behalf of developers (and their "community") is that we are anti growth. We may have personal opinions but our work is to determine reasonable alternative futures and have no intention of convincing the "public" (or "publics") to adopt strategies that could be used to deny growth. In fact we state to developers that our work might be used as a road map by them to help strategize how to avoid roadblocks or other impediments toward their interests.
"Pont" 2: I was the Chair of the Group of Experts (the "GoE" was set up by the UNCCD as an independent group to provide advice on a variety of issues) of the UN Convention to Combat Desertification and was constantly asked about my opinion on climate change as related to people suffering as a result of desertification. In fact, at one meeting of the Conference of the Parties (all 191 signatories to the Convention). I was told not to bring up climate change. I won't tell you by whom, but you can guess. That "request" made me bristle but also to think about it. I find myself being asked by a lot of people who do not "believe" in human-induced (or human impacted) climate change. They frequently ask for my opinion or say things like "you don't really believe in this nonsense do you?" (I really do get a lot of these kinds of questions). My response usually starts with a brief statement that I think that the preponderance of evidence and the vast majority of scientists (and I do know and like George Taylor at Oregon State!!) considers the relationship between rising CO2 levels and increased temps to be pretty compelling and then I go on to say that for the people who are affected by global warming (or intense cyclical variations in climate variables), they really don't care about whether or not it's exacerbated by people or just a natural variation. They need to make sure that their children don't die tomorrow or next week. As such, I state that it is important theat we develop strategies to allow us to cope with the realities of what we are oberving and what people face. Unfortunately, while people in developing countries who are facing land degradation have a profound feeling for the welfare of their children and their children's children, they are concerned about today. Most of us think about these long term consequences (and the solutions are also long term). I think it is difficult to get most "ordinary" people to come to the realization that they may need to do something today so that the problems will be eased in 40 years.
whew.

I am not going to participate because your questionnaire is silly. It suggests that you are not familiar with the science of climate change. Why do you ask if we believe temperatures have generally rise, fallen, or remained the same? The science is clear and there is only one correct answer. This is not a matter of opinion. If some people don’t know the answer, they have just not been very awake for the past decade or two.
Same for the question about human activity.
And your question about the most compelling reason contains no good compelling reasons in the answer list.

You will have to be very careful in your interpretation of answers as there is a wide range of knowledge about climate and climate change in the science community.

Interesting - I went and had a look at the link, scrolled through the questions to get a sense of it, provided no answers, got to the end and ended, but now I can't do the survey. It (the software goofies) think I've already done it, but all "they" have is a set of blank answers. Too bad they didn't think about this at the start. I hope your survey is not compromised by me and others who are likely to explore first.

I appologize, but as an objective scientist I do not communicate "opinions" or "attitudes". These do not belong on the scientific adjenda and certainly not in the classroom. Thus I decline to contribute to your survey.

I had to terminate the online survey because the answer categories are insufficient beginning in the first question. For example, there is no "fluctuated" included in the choice of responses. Also, "pre 1800's" should not be in the possessive form.

Sorry, but I was turned off by the first question. Do pre-1800 levels extend back to the Cretaceous, or even further?

I filled out your questionnaire, although I suggest that you present your case with a bit more formality hereafter. I suspect some senior faculty declined to participate, believing the presentation of your request may not have demonstrated appropriate academic etiquette. Even as a senior faculty member and former departmental chair, I would never present a request to another faculty member unknown to me by addressing him/her by a first name.

A couple of notes. You first question "compared to pre-1800's levels". I found this ambiguous as pre-1800 levels showed a tremendous amount of variation. It might be better to say compared to early 1800 levels if you want a comparison through the industrial age.

Second, your amount of published work related to climate change should have more categories. I would never categorize my work as less than 50% related to climate as virtually nothing I have published relates to climate change.

Maggie: as there are so many bogus surveys out there (and bogus petitions etc) I'd like to know who is sponsoring this and why are you doing it? What does your survey intend to add to the science of climate change? Also, who has been asked to respond, besides me?

I just completed the survey. I do have some feedback to offer:
- I was initially put off a bit by your request for a couple of reasons. One was: you do not explain how you obtained my name and email address to begin with. How did you collect names for the study? I feel that a survey request should include this information. The second one: I think the informal tone (using my first name) during initial contact with a stranger is inappropriate. In fact, I associate this with political spam msgs, and almost deleted your message.
- For the percentage question, I wrote in "99%". Although I don't know the true answer, I thought it a bit strange that my only choices surrounding this one were "90%" or "100%". I am quite certain that 90% is too low, and 100% too high. It is unfortunate that my desired answer was a "write in". As I'm sure you are aware, there is a tendency for people taking a survey to avoid writing in, so it seems your results may be biased to some unknown degree by this effect.
Good luck with the study.

I thought some questions were very poor in terms of their choices of answers.

I fail to see how such a survey could possibly improve our knowledge. Last time I checked science worked on facts/data, not opinions. However, global warming seems to be an exception.

I'm delighted to fill out your questionnaire...interesting Master's project!

Good luck in your thesis study .....

"Veritas vos liberabit".

I am sorry, but I cannot answer some (most actually) of your questions with a simple "Yes" or "No" answer. The area is not clearly black-and-white, I am afraid that it is more complicated than that.... I have nothing against the survey, but oversimplified answers can result in distorted outcome....

Yo, These are loaded questions. Who is your M.Sc. advisor? Please get advice. Global warming causes cannot be determined by an opinion poll. Get with it and understand what the science is. Science is not an opinion.

PS: The cause of global warming is in the final analysis just too many people on earth.

Since I believe taht opnions havelittle relation to valid resultws, I do to want to participate. Unsubscribe.

Nothing personal, but I do not do surveys. Never have and don't plan to in the future.

I have attempted to take your survey, but am dismayed at how it is constructed. Questions 1 asks if I think temperatures are warmer than the 1800s, but doesn't indicate if I'm supposed to compare to today, the last 10 years, the last 50 years, or... Without telling me what I'm comparing to, I cannot answer the question.

Q2 then asks if I think that humans are "a significant" contributor to warming temperatures, but I can only answer yes or no. I happen to think that we are one among many contributing factors, so I answered yes, but I couldn't explain this. The third question then asks me why I think humans are a major contributor, but is phrased in such a way that it's implicit that I'm now listing them as THE significant factor. They are not the primary cause, but I had to stop the survey at this point because it was forcing me to answer queries about why I think they are.

As constructed, your responders will be unable to indicate that there are multiple causes to climate change, that climate change is the norm on Earth and has been going on throughout geologic time, and that there is strong evidence to indicate that climate change not only occurred before humans existed, but also was probably more extreme than the event we are living in today.

I generally don't participate in surveys. I think the evidence for human responsibility for climate change is pretty strong and should be acted on, particularly by reducing carbon emissions. Reducing fossil fuel consumption is Win-Win -- Even if the hypothesis of CO2 involvement turns out to be incorrect, dramatic reduction in oil consumption has many beneficial consequences.

I applaud your effort with this survey to establish data regarding the conclusions drawn by geoscientists about anthropogenic global warming. In the spirit of constructive feedback, I offer this observation:

One question struck me as poorly constructed. You asked what percentage of one's research papers published were on topics related to climate change. The possible choices were > 50%, <50%, and "not applicable." Presumably, the majority of geoscientists (like myself) do not work directly on climate change research (certainly that's true of the majority of AGU members). I didn't know whether N/A or <50% was the appropriate response -- yes, I publish, but not about climate. Seems like more choices of response for this one question would give you a lot more information...

I do find your question most ambiguous.
What do you mean by "pre-1800s global temperatures"? For me, this implied a lack of quantitative reasoning which unfortunately seems to characterize many people concerned by environmental problems. It always turns me off, particularly when the persons involved belong to an organization that has "Sciences" in its name.
By pre-1800s, do you mean the century before, the millennium, or a longer period? Pre-1800s for an earth scientist like myself can be as long as the age of the earth itself, i.e., 4.5 By. But, of course, there is no information about a time as long as that.
I am retired since 4 years to another continent where I do not have easy access to the recent literature. Of course, I follow through the popular press the current thinking but, frankly, I am no more impressed by the recent attribution of the Nobel Peace Prize than by the assertion of the presence of WMDs in Irak long advocated by the press and which was revealed to be wrong, in other words there can be a lot of brainwashing resulting from press, radio, TV messages. Beware of that!
I will not argue with the fact that the CO2 in the atmosphere as increased due to human activity. But I also appreciate that there are many unknowns in the climatic models and, in particular, in the relation between CO2 and atmospheric and surface temperatures and, therefore, I am not convinced that the warming trend is of human origin.
You may have heard of the petition, supported by a distinguished past president of the USA National Academy of Sciences Fred Seitz, urging the USA government to reject the Kyoto agreement. I did not sign it but the information that was appended to it definitely casts doubt on the prevalent opinion diffused by the press.
The sea surface temperature is presently the same as the 3,000-year average and the arctic air temperature since about 1700 correlates with the solar activity, and NOT with hydrocarbon use.
So, we are in a global warming period, since the Little Ice Age, and it will have consequences that are huge in terms of population survival in certain regions and their migration to other more auspicious areas, with complex political implications as well as probably wars. Whether our leaders will be wise is not sure. Reducing our dependance on hydrocarbons is to be commended (if only for our health) but promoting biofuels that will compete with the basic foodstuff and lead to their increase in price and their inaccessibility for many on this planet is insane. We already see this starting to happen right now.
In conclusion, I urge you and all who call themselves environmental scientists to always apply scientific rigor and consider all FACTS before unloading grandiose conclusions on the gullible public.
Wishing you well in your studies.

I have answered some questions from your survey and some I have not answered because they are vague. e.g. Your question #1 asks that if the global temperature of today has changed as compared to –pre1800 level, this is an open ended question , how far you want to go back in the past 1000yr, 5000 yr, or 10000 yr. An other of your question is linking only human activities with the temperature changes while ignoring some natural factors which may be playing a significant role. Then you are

asking about the % of geoscientists who seem to be supporting the certain views, unfortunately science does not follow the principle of democracy, therefore the number of scientists supporting a certain idea does not validate or reject it, same can be said about the number of the published articles (their number should not be taken into consideration as a conclusive factor). Personally my studies are telling me that global temperature changes are inevitable, the more important factor is the unchecked population growth, and unless you take the population level back to the year of 1930 none of our actions will solve the disaster where we are heading to. I am sorry that if my answers did not meet your expectations.

**I expect to hear whatever the true thoughts of the individuals I am surveying are, so indeed, I am happy to receive your email! The questions were written very broadly - something that undoubtedly makes some scientists uncomfortable, but characterizing such a large group necessitates short answers. Please trust that this is not an attempt to confirm or dispel the notion of global climate change, but rather to comment on what and HOW geoscientists think about the issue.*

Again, I thank you for taking the time to share your thoughts with me, it helps me understand how participants interpret my questions, and in turn, helps me understand how to interpret my results.

Thank you for your note. I agree with you very strongly that at this time our species is responsible for some serious environmental degradation. The facts are that, a) CO2 in our atmosphere has already crossed the threshold of 385 ppm and it will continue rising for at least 150-200 years, b) globally glaciers are in a shrinking mode which means that the earth will be reflecting lesser amount of solar radiation consequently retaining more heat, and as the alpine glaciers melt away giving few years of increase in the river's discharge but eventually this source will vanish which is alarming because the amount of available fresh water is already much less than what we need, c) sea level is rising and rate is accelerating, this is noticeable especially in places like low relief islands of different oceans, and in the countries like Bangla Desh. More over the average temperature of oceans is rising which may result in release of CO2 (currently they are a large sink of CO2).Increase in the surface area of the oceans will retain more solar radiation which definitely will increase the global temperature, d) an average increase of 4 degrees Celsius in global temperature can bring a green house scenario, and e) of course deforestation is not only adding CO2 to the atmosphere but the lack of terrestrial flora will decrease the recycling of the CO2. Last time when some significant change in the global temperature took place there were far fewer members of our species living on this earth, today any global disaster will affect billions of people. I do not see any serious effort to prepare human race for any global disaster.

Good luck.

Your first question is ill-posed in that it does not define the periods for temperature that need to be compared. Pre-1800's leaves 4 billion years to consider. I answered anyway.

From my perspective, the most compelling evidence is the documented ensemble of interrelated chemical, physical, and biological changes that are generally consistent with predictions based on state-of-the-science earth systems models. These relationships are well documented in the latest report of the IPCC.
Good luck with your work.

I will not be taking part in your on line survey. I believe some of the questions require background information that I do not have. Without such information answers will only be guesses of the type

that create much confusion in the current climate change debate.
I don't believe random surveys make meaningful contributions to our understanding of the problem.

I have no particular expertice in this field, and therefore my opinion is no better than you might get from "the man on the street." In 30 years of field work, I've noticed variations in weather that make me think a shift is underway, but then (as an example) winter lasts into tax time (2008) and my observation of a trend is shattered. I've been in the northern Minnesota on 90 degree days in April (~1985), and seen significant snows in September (~2006)--what does this tell us? Beats me.

Your question about how temperature has changed since the pre-1800's should be qualified better. Do you mean in comparison to the 1700's, or since 0 A.D., or since the Egyptian empire, or since 10,000 years ago at the end of the last ice age, or an even longer time scale such as within the Quaternary time period? There have been significant cyclical events in global climate over the past several thousand years that affected ancient civilizations. The scale is not clear and will affect how your survey results can be interpreted.

Am I missing something? Are we acquainted (you addressed me by my 1st name)? Why you are asking me to do this?
I have no opinions of consequence on climate change.
Moreover, I avoid surveys unless I see a clear impact to be had from them. Generally I view them as time wasters. I've rarely seen much impact result from most surveys of any kind.

There's NO WAY I'll click a hot link sent by email from someone I don't know! We have a dreadful time here with ingenious fake messages every day and only keep our computers virus free by being extremely vigilant.

Now I've seen your follow-up message and checked your address, I'm inclined to think that you're genuine. So here's my response. As someone who spent a lifetime studying igneous rocks and similar things, I have NO authoritative view about global warming in the future. As an earth scientist, I know perfectly well that the Earth has ALWAYS been changing its climate drastically, especially during the last few Myr. The site of the house where I live in northern England was under thousands of feet of ice (in a glacier) a few thousand years ago. My ancestors then lived on the floor of the present North Sea and further south. They were chased uphill onto the present landmass by sea levels steadily rising.

Anthropogenic global warming may well cause more changes worldwide as drastic as England has seen since the last glacial period. The problem is NOT the occurrence of such changes to and fro, it's the POLITICAL fallout now that global populations are huge and folk have developed silly human notions like land ownership and nationhood. The planet will go its own sweet way but us humans are going to have one heck of a time coping with such changes!

I figured I would try out this survey, since I've been asked twice. I have an issue with #1 though: When you say "pre-1800's levels", you need to define the time period. Some pre-1800's levels were warmer, some colder. For a long-term average, relative to the past several hundred million years, we are in a relatively cold period, due to continental configurations. Relative to the past several hundred thousand years, we are in a relatively warm period, as it is an interglacial at a time when continental configurations are conducive to ice ages. Temperatures now may be comparable to those at the peak

of the Roman Empire. Relative to hundreds of years pre-1800, it is warmer now, but the choices in the pull-down menu suggest that you are not very familiar with these issues.

**I thank you for your participation and for taking the time to share your thoughts with me. Wording questions is the trickiest part of surveying, and we put a significant amount of time into developing our line of questioning and trying to root out all the possible issues. Clearly, our effort to create a simple and generalized question did not go as well as we had hoped with the first question. The time-scale leaves room for ambiguity, and I will be sure to take that into consideration when I am interpreting my results. Be sure that these questions were reviewed many times by a variety of professors with different areas of expertise, including climate science, but when we have such a clear idea of what we are asking, it can be difficult to identify questions that will be read differently by our participants. In any case, I want to thank you again for your email. Any feedback (good or bad!) helps me to understand how my participants interpret my questions, and in turn, how I should interpret their answers.*

Thanks for responding. Will the results of the survey be made available to the participants? I would be curious to see.
One new concern that I have based on what you said below - when you say "we have such a clear idea of what we are asking", it almost suggests that you have an outcome in mind already, and you want some survey data to back it up. As an educator, and also as someone who is very concerned about anthropogenic climate change, I have worked hard to do all I can to make sure I am not a victim of my own biases and perceptions. This is extremely difficult. At times, I get frustrated with some in the climate change community who seem to have blinders on in exactly the same way that we accuse those who deny the problem do. I don't know how you feel about this issue, but I would ask you to consider this, and make sure that you do the same.
Best Wishes for success in your project.

** I will be happy to send the results to you once the survey is done. The survey will be active until next Thursday, so expect to hear from my sometime after that.*
It is challenging to keep our own biases in check when conducting a survey like this. When I said "we have such a clear idea of what we are asking" I meant that we have been over and over many versions of the same questions, looking for the most neutral wording, so it becomes difficult to look at each question though fresh eyes and see where the issues might be. This entire process has been an exercise in re-educating myself about the climate debate and, in the process, I can honestly say that I have heard very convincing arguments from all the different sides, and I think I'm actually more neutral on the issue now than I was before I started this project. There is so much gray area when you begin to mix science and politics, environmental issues and social issues, calculated rational thinking with emotions, etc. I have told my committee and anyone who has asked (or will listen!) that what I hope to find in my survey is what the PARTICIPANTS think, not what I think. What I think isn't interesting, but what over 2500 geoscientists think is!
I've labored to make this process as transparent as possible, and to improve of past survey attempts in many ways. I am making data available to those participants who ask, and responding to all the emails I receive in an effort to acquire a robust and legitimate data set to work with. While I don't doubt there will be all sort of new criticisms, I have tried to set up a good survey that accomplishes my original goal: to characterize what and HOW geoscientists think about this issue.

Please forgive me, but have we met previously? If not, then I am curious how you ran across my name to invite me to participate. In addition, has this questionnaire been approved by UIC's Human Subjects/Institutional Review Board? Please understand, I am not trying to hassle you, but prevent you from running into troubles with the IRB at your institution. There just seemed to be some contact information missing from your cover page/consent form.

**Thank you for your email. I got your name from a directory of faculty associated with geoscience departments in the U.S. and abroad. My project, the questionnaire, and the email invitation that was sent were all approved by UIC's IRB. If you would like to follow-up, the Research Protocol number for this project is 2008-0228, and is on file in our IRB office, which can be reached at 312-996-1711.*
What type of information do you think is missing? I will be happy to provide it to you if you let me know!

Thank you for the reply. If it has been reviewed and approved by your IRB, then that is fine. I have been on the IRB here and at my former institution for the last 7 years, and so I am very sensitive to these issues. And having recently received some strange mail from Ghana, I am just doubly on guard. Can you tell me more about your study?

Just a quick note to give feedback on why I bailed out of the survey.

"Question 1: When compared with pre-1800's levels, do you think that mean global temperatures have generally risen, fallen, or remained relatively constant?" 1800 -> when? Time frames for such comparisons are critical, as there is clearly natural variation that we are trying to separate from an anthropogenic effect. It did not make sense to continue given that none of the allowed responses were valid (this is not a case of 'no opinion/don't know').

This was a very simplistic and biased questionaire. Considering it was aimed at geoscientists, it had no time depth consideration at all, not even the short-range time depth of including the Little Ice Age, let alone the influence of orbital cycles, etc. I'm not sure what you are trying to prove, but you will undoubtably be able to prove your pre-existing opinion with this survey!

I'm sorry I even started it!

Just filled out your survey and I have a suggestion. You need a question that asks to what degree we think human activity has influenced climate. I am pretty sure our activities have had a significant effect but not convinced that all of the warming we see is directly attributable to anthropogenic activity. To me that is a somewhat different answer than what you will get by just looking at my answers to your questions.

What are you going to do with the results. Since NPR said this morning that half of people in USA don't believe humans have an impact on climate, I'm curious to know what you find out.
And how did you select people to survey? What is the focus of your thesis?

**Thank you for your participation! My first and foremost plan for the results is to finish my M.S. thesis. We will likely try to put out an article on the results, but where and when that will go is still up for debate. If you are interested, I would happy to add you to the list of participants who would like to see the results once the survey is complete.*
I got all my participants names and contact information from a directory of faculty associated with geoscience departments in the US and abroad.
My thesis focuses on the debate about the scientific consensus on climate change, the history of the debate, the main players, and data they rely on, and now the survey, which attempts to assess the consensus among geoscientists, the perception of consensus among geoscientists, and how they arrive at those conclusions.
If you have any other questions, please feel free to email me!

Yes please add me to the list who would like to see the results.
I was curious about where you got the names since I've been involved with focus groups and data collection about women in the geosciences and use the AGI database. Sometimes there are problems with that and I was wondering it there is a better option.
Sounds like an interesting project. Good luck with you masters.

**I will add you to the results request list! I did use the AGI 2007 Directory of Geoscience Departments. The biggest problem I have run into there is that it includes departmental admins, not just faculty, so I originally sent it out to all of them as well (one of the questions in the survey asks about education level and expertise, so it's easy to filter those responses out fortunately). I ended up receiving emails from most of the admin people saying they weren't actually geoscientists, and they were nearly ALL women. Of my current respondents, only about 20% are women. Are you involved in the AWG at all? If not, they may be a good resource if you are looking for contact info for women in geosciences.*

Curious that only 20% of respondents are women. Maybe the ones with jobs are too busy to even read their email. I am a member of AWG and think it's an excellent organization. Do you go to GSA? And the AWG breakfast? It's early but fun.

I did not want to complete it until I saw all the questions. When I got to the end after hitting continue on each question, it kicked me out and wouldn't let me back in. If you let me in again, I will fill it out.

I did participate in the survey but was a bit concerned in that some of the questions seemed to be open ended. For example while I do not believe that anthropocentric activity is entirely responsible for global climate change, they certainly do contribute.

After thinking a while about the questions, I wish that I had not participated in the survey because of the way that the questions could be misconstrued.

I just logged on to your survey and thought I'd let you know that I find it very interesting but also found a couple of things you might want to think about. Your first question asks whether it is my perception that temperatures have risen, fallen, or stayed the same relative to pre-1800s levels but you provide no timeline within which to make this judgment. I answered risen because I'm assuming you're wanting us to compare the last few hundred years. Of course if you use the Cretaceous as your yardstick, temperatures have obviously fallen - also if you use isotope stage 5e. So, I'm not sure how people are going to answer this question.
I'm also not sure if your question #3 has enough nuance. As a climate scientist, I am aware of the problems in the CO2/temperature question - i.e., which led which. Still, even if CO2 changes follow temperature changes caused by orbital cycles, CO2 appears to be a huge amplifier of small changes in insolation, so it stands to reason that increasing CO2 further will further increase temperature. I don't know whether people will find this problematic or not as they try to answer the question.
I'll be interested in reading your results when you publish this. If you wouldn't mind keeping me on your list for people to send the study to, that'd be great.

I would be interested in getting the results of your survey, and in particular the comments of some of your respondents. I personally am not a climate researcher. I'm a Pleistocene geologist – retired

from university teaching - and presently working as a consulting engineering geologist. However, I'm interested in the ongoing controversy regarding climate change, and admittedly am a bit skeptical about some of the claims being made on what appears to be minimal data. So I would be interested in the results of your survey.

I just took your survey and would be interested in learning about the final results! I didn't answer question # 1 though, because it was not a well posed question. Did you forget that you're talking to geologists? You can't simply ask about temperature in the pre-1800's..... what geologic age are you referring to? There have been great variations in temperature over the earth's history.

I would be interested in learning of the results. Please remember that 'geoscientist' includes a wide range of professionals, including a sizable group who work for oil and gas companies, and may have an opinion based less on science than job security. You might solicit a climate change statement from the major geosciences professional organizations (many have statements on their websites) . You will note a significant difference between AAPG, GSA, and AGU.

Good luck..I'll be interested in your findings..especially the question on percentage of geoscientists considering human activity and climate change.

I would like to know the results of your study. I have no doubt that human activity is increasing CO2 concentrations in the atmosphere and causing global warming.

I look forward to seeing your results. I would think that, if your target audience is limited to those geoscientists who work at or through a university geoscience department your results should be heavily biased to those who are pro-anthropogenic cause for global warming. So, it will be interesting to see if that hypothesis bears out. Does your group plan to do this same survey to different target audiences and compare the results?

IRB Exemption Approval

UNIVERSITY OF ILLINOIS
AT CHICAGO

Office for the Protection of Research Subjects (OPRS)
Office of the Vice Chancellor for Research (MC 672)
203 Administrative Office Building
1737 West Polk Street
Chicago, Illinois 60612-7227

Exemption Granted

March 19, 2008

Margaret Zimmerman, BA
Earth and Environmental Sciences
845 W. Taylor St.
M/C 186
Chicago, IL 60607
Phone: (312) 996-3159 / Fax: (312) 413-2279

RE: Research Protocol # 2008-0228
"Finding the Consensus on the Consensus: Using Survey Techniques to Assess the Opinions of Geoscientists on Global Climate Change"

Dear Ms. Zimmerman:

Your Claim of Exemption was reviewed on March 19, 2008 and it was determined that your research protocol meets the criteria for exemption as defined in the U. S. Department of Health and Human Services Regulations for the Protection of Human Subjects [(45 CFR 46.101(b)]. You may now begin your research.

The specific exemption category under 45 CFR 46.101(b) is:

(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

You are reminded that investigators whose research involving human subjects is determined to be exempt from the federal regulations for the protection of human subjects still have responsibilities for the ethical conduct of the research under state law and UIC policy. Please be aware of the following UIC policies and responsibilities for investigators:

1. Amendments You are responsible for reporting any amendments to your research protocol that may affect the determination of the exemption and may result in your research no longer being eligible for the exemption that has been granted.

2. Record Keeping You are responsible for maintaining a copy all research related records in a secure location in the event future verification is necessary, at a minimum these documents include: the research protocol, the claim of exemption application, all questionnaires, survey instruments, interview questions and/or data collection instruments

associated with this research protocol, recruiting or advertising materials, any consent forms or information sheets given to subjects, or any other pertinent documents.

3. Final Report When you have completed work on your research protocol, you should submit a final report to the Office for Protection of Research Subjects (OPRS).

4. Information for Human Subjects UIC Policy requires investigators to provide information about the research protocol to subjects and to obtain their permission prior to their participating in the research. The information about the research protocol should be presented to subjects in writing or orally from a written script. When appropriate, the following information must be provided to all research subjects participating in exempt studies:
   a. The researchers affiliation; UIC, JBVMAC or other institutions,
   b. The purpose of the research,
   c. The extent of the subject's involvement and an explanation of the procedures to be followed,
   d. Whether the information being collected will be used for any purposes other than the proposed research,
   e. A description of the procedures to protect the privacy of subjects and the confidentiality of the research information and data,
   f. Description of any reasonable foreseeable risks,
   g. Description of anticipated benefit,
   h. A statement that participation is voluntary and subjects can refuse to participate or can stop at any time,
   i. A statement that the researcher is available to answer any questions that the subject may have and which includes the name and phone number of the investigator(s).
   j. A statement that the UIC IRB/OPRS or JBVMAC Patient Advocate Office is available if there are questions about subject's rights, which includes the appropriate phone numbers.

Please be sure to:

→Use your research protocol number (listed above) on any documents or correspondence with the IRB concerning your research protocol.

We wish you the best as you conduct your research. If you have any questions or need further help, please contact me at (312) 355-2908 or the OPRS office at (312) 996-1711. Please send any correspondence about this protocol to OPRS at 203 AOB, M/C 672.

Sincerely,

Charles W. Hoehne
Assistant Director, IRB # 2
Office for the Protection of Research Subjects

Enclosure(s): None

cc: Neil Sturchio, Earth and Environmental Sciences, M/C 186
Peter Doran, Earth and Environmental Sciences, M/C 186