

Chapter 3

Polluted Discourse: Communication and Myths in a Climate of Denial

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Abstract Human activities, principally the burning of fossil fuels, are changing the climate. Despite widespread scientific consensus on this fact, communicating the risks posed by climate change to the public remains challenging. We examine the role of contrarian narratives in climate communication, focusing on two terminological claims—(1) that scientists abandoned the term *global warming* in favor of *climate change* in response to a change in temperature evolution, and (2) that *catastrophic anthropogenic global warming* is the mainstream scientific position—and find them to be without merit. We discuss how scientists and communicators can neutralize these myths while informing the public. Finally, we summarize the existing literature on word choice in climate communications and suggest best practices based on target audiences.

Keywords Climate change • Global warming • Terminology • Science communication

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3.1 Introduction

3.1.1 *Climate Communication*

The scientific community overwhelmingly agrees that humans are changing the climate (Anderegg et al. 2010; Cook et al. 2013; Doran and Zimmerman 2009; Oreskes 2004). However, significant obstacles to effective public understanding of the problem currently prevent mitigating and adaptive actions (Gifford 2011). There has been a great deal of interest in the role of denial or contrarianism as one such obstacle, be it the role of industry-funded *think tanks*, which serve as well-moneyed front groups for anti-regulatory campaigns and narratives (Brulle 2014; Dunlap and Jacques 2013; Oreskes and Conway 2010), or the dimensions and causes of the partisan divide in public opinion (Dunlap and McCright 2008; Guber 2013; Malka et al. 2009).

We focus on the role of contrarian myths, which can be both a contributing source to and an amplifier of this partisan divide and the scientist-public disconnect. By their very nature, contrarian myths often bypass the normal societal filters against misinformation, such as journalistic fact checking or academic peer review (Elsasser and Dunlap 2013). While addressing the underlying drivers of climate denialism is invaluable, addressing myths directly is worthwhile in its own right. Rebutting myths may not itself be sufficient to cause committed partisans to change their position, but it has the potential to prevent propagation of myths to those who are undecided or disengaged. We are hopeful that by reducing the persuasive efficacy of myths, rebuttals can lead to a reduction in their use. Effective refutation of these myths may necessitate multichannel rebuttals, including rebuttals in scholarly, mainstream, and social media (Cook et al. 2014). Although social media outlets (e.g., SkepticalScience.com) have begun to address the problem, journalistic and scholarly refutations remain the exception (e.g., Peterson et al. 2008) rather than the norm.

3.2 The Terminology of Environmental Change

A potential source of misconception and misinformation in communicating environmental risk is the often overlapping, but not precisely equivalent, meanings of different terms used to discuss aspects of environmental change. *Global warming*, *climate change*, and *global environmental change* can all refer to the present human-caused warming of the planet, though each can also refer to specific aspects of environmental change that the others may not encompass (see Fig. 3.1). Thus, it is possible to have climate change that is neither global nor warming, global warming that is not anthropogenic, or anthropogenic global environmental change that is neither warming nor climatic. Scientists and communicators who wish to reach lay audiences should be mindful that terminology, especially terminology with technical as well as general meanings, can confuse instead of clarify (Somerville and Hassol 2011).

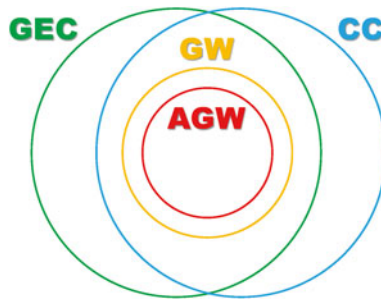


Fig. 3.1 Euler diagram of overlapping terms for environmental change. Overlapping but noninter-changeable terms for environmental change: *GEC* global environmental change, *CC* climate change, *GW* global warming, *AGW* anthropogenic global warming

Global Warming *Global warming* (GW) is a relatively narrowly circumscribed term, typically referring to a sustained increase in the mean surface temperature of a planet. GW can refer to changes caused by human activities, such as in the present warming of the planet through our increases in greenhouse gases and other changes in radiative forcings. GW may also occur in response to natural changes in radiative forcings, such as an increase in solar activity (Lockwood 2012) or an increase in greenhouse gases due to volcanism (as during the Permian-Triassic mass extinction; Cui and Kump 2014; Joachimski et al. 2012). Anthropogenic global warming (AGW) refers specifically to human-caused warming and is therefore a subset of GW. Although the phrase GW is primarily used in reference to Earth, it is also applicable to other planetary objects (e.g., Fenton et al. 2007).

Climate Change *Climate change* (CC) is a more encompassing term and may refer spatially to national or smaller scales (e.g., Salnikov et al. 2014; Coulson et al. 1993), or to scales as large as planets (e.g., Solomon et al. 1999). Unlike GW, CC need not refer only to an increase in the mean temperature of an area, nor necessarily to a change in any average at all; CC can refer to changes in the statistical properties of a wide range of climatological features or processes, such as the prevalence of extreme events (Meehl et al. 2000). In addition to changes in temperatures, CC can also refer to changes in the mean, extreme, or spatial distribution of precipitation (Wigley and Jones 1985), changes to the persistence and distribution of droughts (Shaw 2003; Touchan et al. 2011), changes in the frequency and intensity of tropical cyclones (e.g., Elsner et al. 2008), or other changes to the typical properties of climate.

Global Environmental Change An overlapping term is *global change* or *global environmental change* (GEC). While GEC can refer to global warming or climate change, it is also frequently, and sometimes preferentially, used to describe global-scale environmental problems unrelated to climate change, such as habitat fragmentation, invasive species, biodiversity loss, or freshwater usage and contamination (Stern et al. 1992; Tilman et al. 2001; World Health Organization 2005). GEC can also encompass geochemical changes resulting from the increase of greenhouse gases such as ocean acidification (Beman et al. 2011) or other industrial

emissions such as acid rain or stratospheric ozone depletion (Mazur 1998; The Social Learning Group 2001) that are not strictly considered climatic changes in and of themselves.

3.2.1 *Myths and Implications*

Several contrarian myths have arisen around the terminology of human-driven climate change. Here, we focus on two: (1) that GW was the preferred terminology of scientists, but was recently abandoned in favor of CC, and (2) that *catastrophic anthropogenic global warming* (CAGW) is the mainstream prediction of the scientific community and thus forms the justification for policy. Both of these myths implicitly call into question the credibility of the scientific community and those who convey its results. The GW vs. CC myth portrays scientists as both incompetent (incorrect in their predictions of temperature evolution) and dishonest (engaging in revisionism by “moving the goalposts” in order to encompass previously unanticipated events). The CAGW myth portrays the mainstream as doomsayers who are constantly rebuffed by study after study within climate scientists’ own field.

3.2.2 *Global Warming Versus Climate Change Versus Temperature*

Both CC and GW have been in use by the scientific community for many decades. Usage of CC can be traced back at least to the 1920s (Joffe 1929; Willis 1925), and the similar term *climatic change* can be traced back at least to the 1850s (Anderson 1857; Mayer 1856). The first use of the term GW has been popularly attributed to Broecker (1975), but we found that it had been used more than ten years earlier. Although Broecker was one of the first to use it in the context of the current warming, Mitchell (1961) used GW in a similar context.

Yet a frequent contrarian claim is that the term GW had been the preferred terminology, but that it was recently abandoned in favor of CC. This myth is often made in conjunction with the allegation that global warming has stopped, or that it is presently cooling as in the following example:

Human-caused global warming’ has now officially been re-named ‘climate change’ to explain the inconvenient truth that the winter of 2007–8 was the coldest in a century, in spite of all those tons of ‘greenhouse gas’ being spewed into the air from all the new factories in China and India. Worldwide temps dropped 0.6 of a degree C in one year. (Lewis 2008, para. 3)

Likewise, Littlejohn (2012) stated, “When it became apparent that temperatures were actually falling, they simply changed the name of their religion from ‘global

warming’ to ‘climate change’” (para. 9). Given the more encompassing meaning of CC relative to GW, we believe the contrarian myth can be debunked by examining the scientific literature and comparing the two terms’ relative use. Further, we expect there to be no relationship between the preference of GW over CC and observed warming.

3.2.3 *The Scientific Mainstream Versus So-Called “Catastrophic Anthropogenic Global Warming”*

Another claim advanced by those who reject the mainstream scientific agreement on climate is that the consensus position consists of a claim of *catastrophic anthropogenic global warming* or the frequently used acronym CAGW (e.g., Hickey 2014; The Hockey Schtick 2012; Milloy 2012; Starck 2012). However, CAGW is rarely, if ever, defined or sourced to a mainstream scientific organization or study. Any scientific study’s result, or statement by a researcher, that does not fit a contrarian’s personal, flexible definition of CAGW can therefore be adopted as ostensibly supporting their view and refuting the mainstream, even when such results are actually consistent with the mainstream position on climate (e.g., The Hockey Schtick 2014).

3.3 Materials and Methods

3.3.1 *Academic Databases*

To address the claim of CC vs. GW in the scientific literature, we used two established academic reference databases (Thomson Reuters’ *Web of Science*TM and Elsevier’s *Scopus*) to record the returned number of papers for each year between 1950 and 2013 using each search term. The search terms we used were *climate change* and *global warming*. Additionally, we searched the term *catastrophic anthropogenic global warming* in both *Scopus* and *Web of Science*. To assess paper counts that used only GW or only CC, we also recorded the number of papers that used both terms. We then adjusted the GW and CC values by subtracting the results of papers using both terms.

Thomson Reuters’ *Web of Science*TM The *Web of Science* Core Collection contains information about peer-reviewed journals in the science and the social sciences from 1900 till the present. It also contains information about conference proceedings and books; however, we restricted our *Web of Science* search to articles only, ensuring these works would not be included in our search results. A review of *Web of Science* performance can be found in Jacsó (2011a).

Elsevier's Scopus *Scopus* is an abstract and citation database covering the fields of science, technology, medicine, social sciences, and arts and humanities. Like *Web of Science*, *Scopus* also contains information about books and conference proceedings, but here we also restricted our search to articles only. A review of *Scopus*' performance can be found in Jacsó (2011a, b).

3.3.2 Newspaper Databases

ProQuest Historical Newspapers™ The ProQuest *Historical Newspapers™* database provides a full text archive of 36 newspapers spanning 1764–2011. The database covers so-called *prestige press* US papers like the Los Angeles Times, New York Times, Wall Street Journal, and Washington Post, a selection of international papers, as well as collections of traditionally *Black* and *American Jewish* newspapers. We searched for articles including the term *catastrophic anthropogenic global warming* or *CAGW*, but excluding the phrase *Citizens Against Government Waste*, which shares the same acronym and thus distorts queries by returning a prohibitively high number of false positives. We restricted the returned results to exclude the following items: birth/marriage announcements, obituaries, classified advertisements, credit/acknowledgments, illustrations/images/photographs, military/war news, stock quotes, and tables of contents.

LexisNexis® Academic The LexisNexis® *Academic* database was used to supplement the results of the historical newspaper search, with larger coverage, particularly over recent decades when the myth is most relevant. The *Academic* newspaper database contains a full text archive of over 3000 newspapers. We searched for articles including the term *catastrophic anthropogenic global warming* or *CAGW*, but excluding the phrase *Citizens Against Government Waste*. We restricted the source type to newspapers only.

3.3.3 Activist Websites and Blogs

We analyzed 72 organizational websites, of which we classified 32 as activist organizations. From each of the 32 websites, we analyzed three pages: the site's home page, its *About Us* page, and a page that discussed the issue of climate change (and/or global warming), if such a page was available. We also searched and recorded the number of hits for GW and CC for each site and calculated a GW percentage from the resulting hits ($P_{GW} = N_{GW} / (N_{GW} + N_{CC}) \cdot 100$, where P is percentage and N is number of hits). We also checked 27 activist blogs in a similar manner.

3.3.4 Global Temperature Data

Time series for the global mean surface temperature evolution are produced by a number of scientific organizations studying climate (see Fig. 3.2a; Brohan et al. 2006; Cowtan and Way 2014; Hansen et al. 2010; Morice et al. 2012; Muller et al. 2013; Smith et al. 2008). To be as generous to the myth as possible, we present our

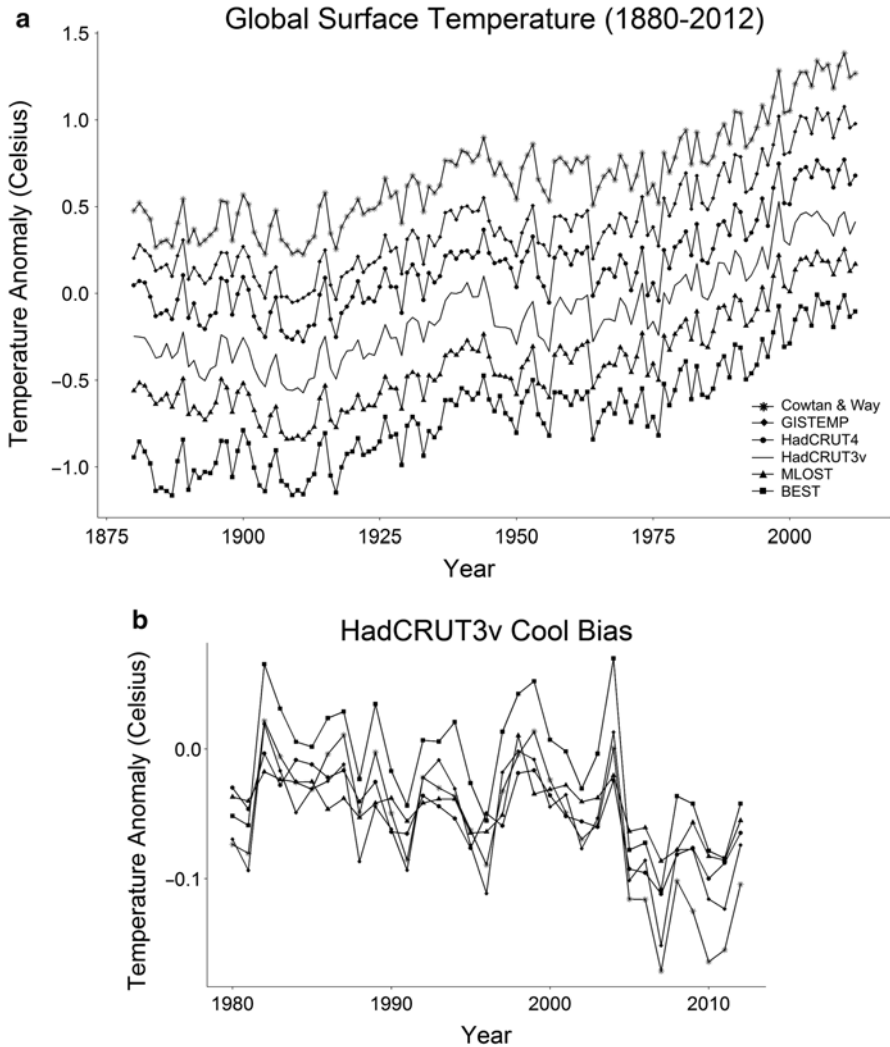


Fig. 3.2 Global temperature records. (a) Globally averaged surface instrumental records from various groups; HadCRUT3v anomalies shown relative to 1961–1990 baseline; other records are offset for clarity. (b) Difference between HadCRUT3v and other records, plotted on a common baseline

analysis using the HadCRUT3v dataset, which suffers from known coverage biases and shows markedly less warming in recent years compared to other surface temperature analyses (see Fig. 3.2b). HadCRUT3v temperature was annualized and downloaded from KNMI Climate Explorer (<http://climexp.knmi.nl/>).

3.4 Analyses and Results

3.4.1 Use of CC and GW in the Scientific Literature

The total number of papers found using each term in each year during the period 1950–2013 is presented in Table 3.1. Papers using CC outnumbered those using GW by around 5–9 times, depending on the database. The evolution of each term over time is presented in Fig. 3.3. Neither CC nor GW was used with much

Table 3.1 Total results for all terms

	Scopus	Web of science
Climate change	75,163	173,647
Global warming	15,672	18,804
Both	8,564	7,136

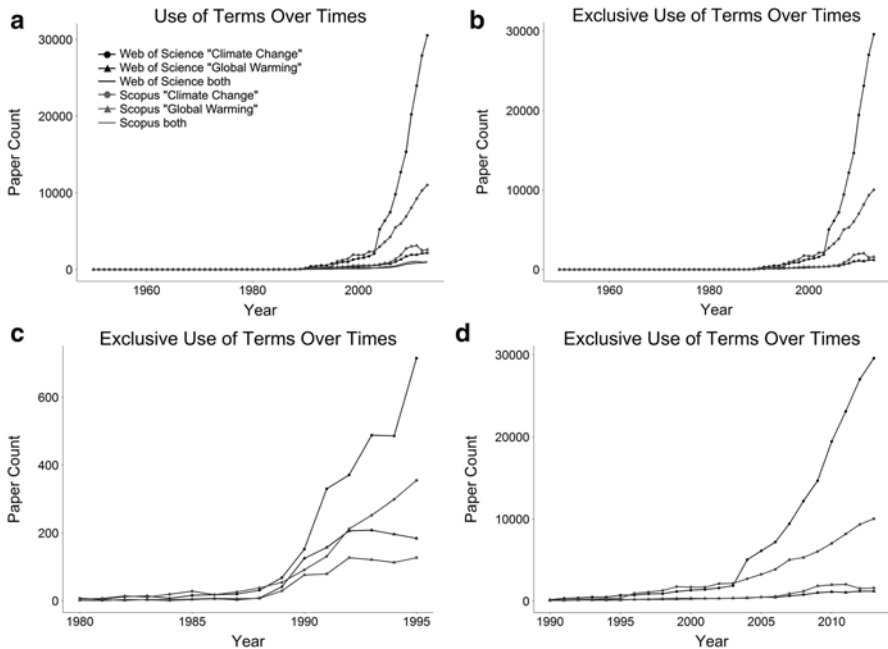


Fig. 3.3 Evolution of term usage over time. (a) Raw paper counts for papers using each term and both terms; (b) adjusted (papers using both terms removed) paper counts; (c) adjusted values from 1980 to 1995; (d) adjusted values from 1990s to 2000s. Annual paper counts in Web of Science (black) and in Scopus (gray) database for CC (solid line), GW (dashed line), and both (dotted line)

frequency until the 1980s. The numbers of CC and GW articles were somewhat similar until the early 1990s, when the increase in the number of CC papers occurs earlier than the increase in GW papers in both *Web of Science* and *Scopus* databases. From the early to mid-1990s, the number of CC papers continues to grow steadily while the number of GW papers remains flat during this period (Fig. 3.3c). An upward trend in GW papers does not resume until the 2000s (Fig. 3.3d).

3.4.2 Change in Usage Relative to Temperature Change

We find that CC has been the more prevalent term at least since the early 1990s, which precludes the claim that it was recently adopted in favor of GW in response to purportedly cooling temperatures. The ongoing warming of the climate system also precludes the possibility of this particular myth being true (Fig. 3.2a). Nor does there appear to be any relationship between the ratio of GW to CC papers and the evolution of global temperatures over time (Fig. 3.4). Nevertheless, we tested for a relationship between GW's preferential use and global temperatures. We performed linear correlation tests (Pearson product-moment correlation coefficient) with annual ratios reflecting the relative usage of CC vs. GW against annual temperature data. Calculations were performed using the *R* statistical programming language (*R*

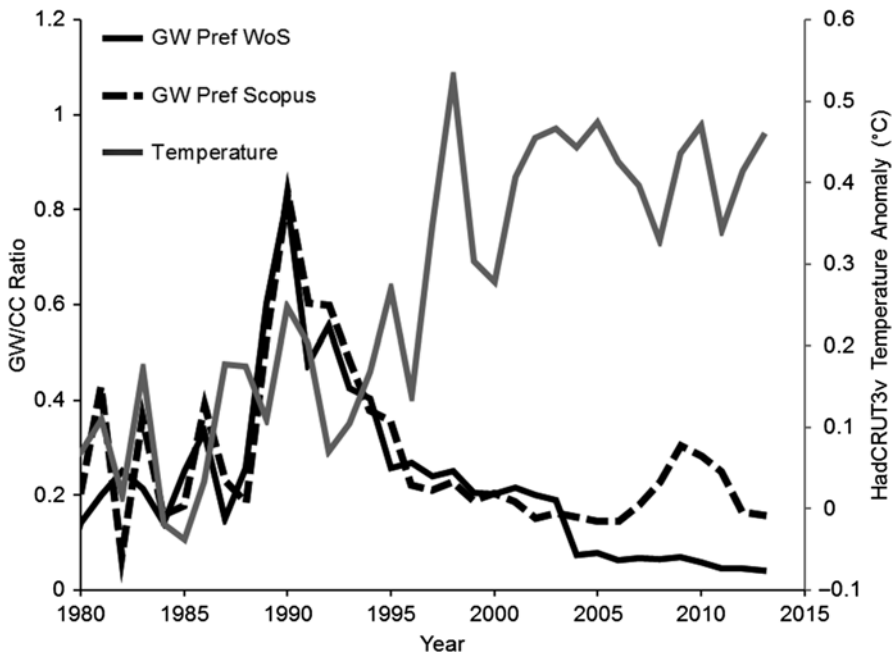


Fig. 3.4 Preferential use of GW vs. CC and temperature change. Change in the preference (ratio) of GW over CC over time compared to the global temperature evolution

Core Team, 2014). For the contrarian claim to be supported, we would expect a higher ratio of GW to CC papers during increasing temperatures and a decline in the ratio when temperature decreases. The correlation test was performed again with lagged responses for the scholarly results (ranging from 1 to 5 years, to allow for the delay between a change in temperature and the writing and publication of a paper). We found correlations in the opposite direction as posited by the myth, and these negative correlations were for the most part statistically significant (Fig. 3.5).

3.4.3 *Activist Websites*

According to our results, about two-thirds of all activist organizations sampled use only CC on their home pages. Most of the remaining third of home pages use neither CC nor GW. Few homepages use GW or both GW and CC. *About Us* pages of activist organization websites use only CC (~70 %) or neither CC nor GW (~30 %). In the activist organization websites, the page that discusses the issue of climate change and/or global warming included both CC and GW in most of the sites (~91 %) and only CC in the rest of the sites (~9 %). Search engines find both GW and CC somewhere within almost all websites of the sampled organizations. Of the number of hits for either CC or GW, on average about one-fifth is GW (GW percentage ~22 %).

Home pages of activist blogs typically use both terms. About 30 % use only CC and 7 % use only GW. *About Us* pages show a similar distribution to home pages, although none used only GW (however, only 15 blogs in our sample had an *About Us* page, so the sample is small here). Only one blog in our sample had a page that describes CC and GW, and this page included both terms. Search engine results show that activist blogs use GW and CC almost in similar proportions. Mean GW percentage is 48 %. None of the blogs use only CC. Of the sources we analyzed, activist blogs clearly have the highest percentage of GW (48 %). Activist organization websites had GW percentage of 22 %. Peer-reviewed papers have GW percentage of 11.3 % when calculated for the years from 2000 to 2013, averaged from Web of Science and Scopus data.

3.4.4 *Usage of CAGW*

The phrase *catastrophic anthropogenic global warming* and its acronym (CAGW) were found only once in our query of the scientific databases (Carlin 2011). It is used by an author taking a contrarian position to the mainstream scientific community, and the phrase is neither defined nor sourced to a mainstream scientific publication or organization. Further, we find the phrase is rarely used in the mainstream press and in the results of our query appears only in opinion editorials, letters to the

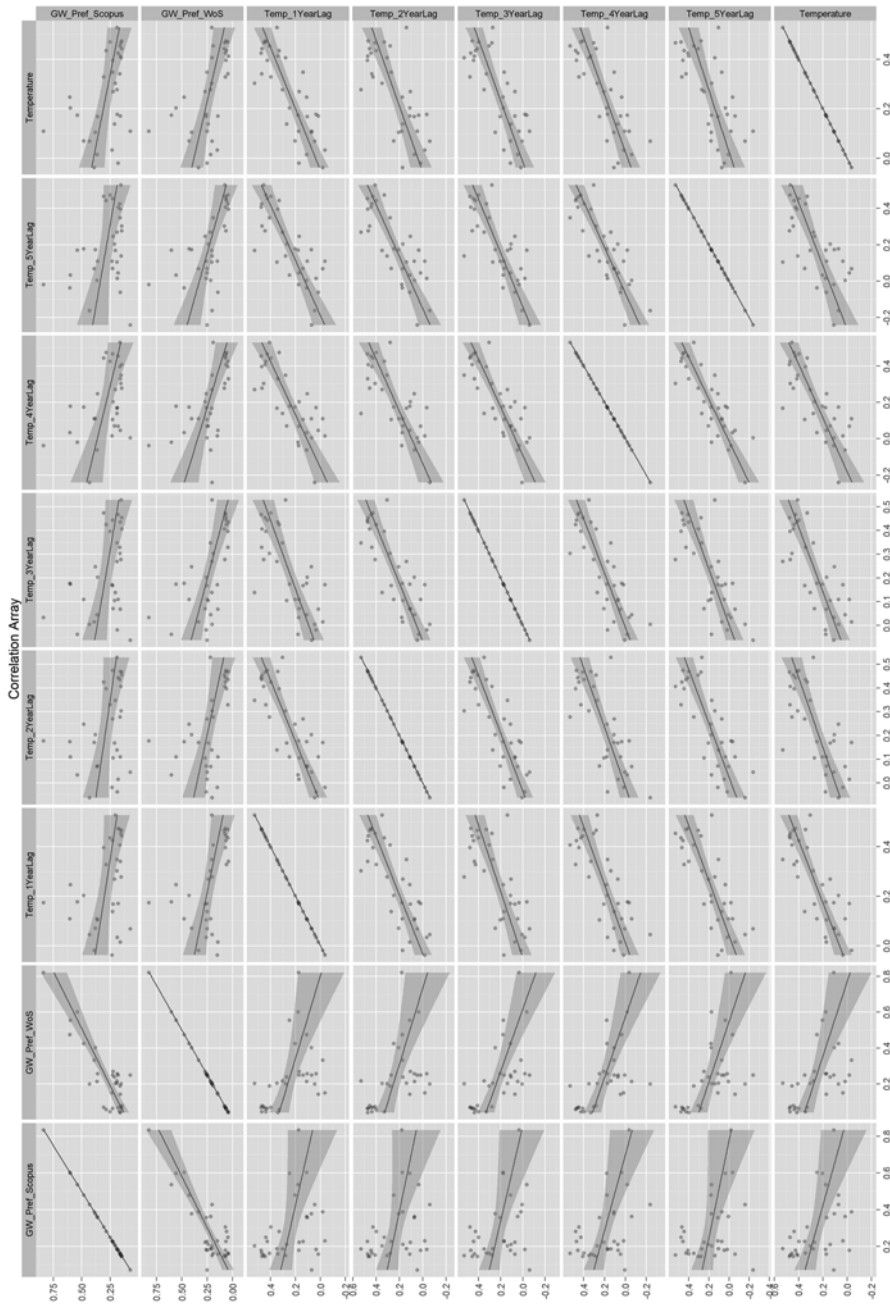


Fig. 3.5 Correlation test results for global warming preference and temperature change. Correlations between the relative preference of GW over CC and global temperature, with lags of 1–5 years

editor, blog posts, or other nonnews items. Again, in all cases, CAGW is used by authors taking a contrarian position to the mainstream scientific view on climate.

Although the databases used in our analyses have their strengths and weaknesses (Jacsó 2011a, b), we believe our results to be robust. Other scientific publications databases exist, but most are either more limited in scope (e.g. PubMed, focused on medical research; BioOne, focused on biological research since 1998) or too broad to be useful in this study (e.g., Google Scholar, or ProQuest, which includes sources far beyond peer-reviewed papers). A number of other terms could be included in future analyses (e.g., global cooling, climate crisis, climate disruption, etc.) but are beyond the scope of this work. Expanding our search to include non-peer-reviewed, nonphysical science scholarly material could return different results; however, the relevance of such queries in the assessment of the position of the scientific mainstream is questionable.

3.5 Discussion

The myth that GW was the preferred term until recently and CC was adopted in response to a decline in temperatures is groundless. In our analysis, CC was used earlier and has been used more prevalently—both overall and in all but a handful of years over the last several decades. Use of GW in lieu of CC does not appear to be related to changes in global temperature; rather, preference for GW is negatively correlated with temperature change. Nor has there been cooling to prompt the purported switch. Changes in solar irradiance, volcanic eruptions, and tropical Pacific variability can give the appearance of periods of flat or even declining temperatures during periods when the overall trend is unquestionably one of warming (Easterling and Wehner 2009; Lean and Rind 2009; Rahmstorf et al. 2012; Thompson et al. 2009). After accounting for such factors, the overall warming trend continues in-line with expectations (e.g., Kosaka and Xie 2013; Huber and Knutti 2014; Schmidt et al. 2014).

Amusingly, the period during the early 1990s–2000s actually saw the sharpest decline in preference for GW relative to CC, even as global temperature was increasing more rapidly than in previous years. This increased warming rate was likely attributable to a rebound from the cooling of the Mount Pinatubo eruption and positive El Niño Southern Oscillation (ENSO) conditions, superimposed on top of the anthropogenically forced trend (Rahmstorf et al. 2007). If the myth was at all based in fact, preference of GW over CC should have climbed in concert with this rapid warming, when in fact it plummeted. The second myth we examined is similarly unfounded. So-called CAGW is not a concept discussed by the mainstream scientific community, let alone its consensus position. Our analysis was restricted to the particular concept of CAGW—other terms would likely return different results. We do not doubt that climate change has been discussed in the context of catastrophe, be it in paleoecological contexts, or regarding the present, human-driven change. However, the specificity of the phrase CAGW, along with its frequent contrarian use and presentation as the mainstream scientific position, lent itself more readily to analysis.

Mainstream goals such as avoiding “dangerous interference” with the climate system (Anderson and Bows 2011; Hansen 2005; Keller et al. 2005; Krieglger 2007; Oppenheimer 2005; Mann 2009; Ramanathan and Feng 2008; Schneider and Lane 2006; UNFCCC 1992) and specific numerical targets such as 2 °C (UNFCCC 2009, 2010) are obviously much lower criteria to satisfy than the undefined CAGW. By its nature, *dangerous* is a conditional descriptor, while *catastrophic* is both higher in stakes as well as more certain. Such a dramatically higher and ever-shifting standard, in combination with its lack of attribution to mainstream sources, leads us to conclude that CAGW exists solely as a straw man of the mainstream position and is used almost exclusively by contrarians themselves.

Given that the examined myths are unfounded, communicators might wonder how to successfully rebut them. Effective myth refutation techniques are explained in depth in Cook and Lewandowsky’s *Debunking Handbook* (2011). Briefly, when communicators are debunking myths, they should: emphasize the core facts of the issue and avoid the tendency to begin by restating the myth; warn the audience that the myth is false before restating it; provide an alternative explanation to fill the cognitive gap left by debunking the myth (e.g., why misinformers promote the myth or what the actual facts regarding the issue are); and, when possible, present rebutting information in the form of, or along with, easily understood graphical representations. Inoculation theory offers a powerful method of myth refutation (Banas and Rains 2010; Compton and Pfau 2009; McGuire 1964) but requires a scenario in which the communicator can introduce the myth to his or her audience for the first time. Inoculation theory suggests that motivating an audience to perceive a myth as threatening (e.g., those perpetuating the myth are trying to take advantage of the audience) and presenting the audience with a preemptive refutation can combine to create resistance to future exposure to the myth, analogous to biological immunity through exposure to weakened or inactive viruses. A final method of myth refutation is agnotology-based learning (Bedford 2010; Cook et al. 2014). Agnotology-based learning is a pedagogical tool that seeks to teach audiences about a subject by having them critically compare a source of misinformation with a refutational text. Directing the audience to identify the flaws in myths themselves can lead to greater and longer-lasting increases in knowledge than passive learning activities like listening to lectures.

Communicators may also wonder which phrase (CC or GW) is the most effective to use themselves. A growing body of academic work has arisen in recent years, investigating the impact of using the term CC or GW with different audiences. According to Schuldt et al. (2011), the magnitude of the partisan divide on climate in the United States is somewhat dependent on the term used. Only 44 % of Republicans believe GW is occurring, while 60 % believe CC is happening. At the same time, Democrats are as equally likely to accept the existence of GW (87 %) as CC (86 %). Likewise, Villar and Krosnick (2011) found that Republicans tend to see CC as a more serious issue than GW (whereas Democrats see GW more serious than CC). Interestingly, Schuldt et al. (2011) find that conservative websites prefer to use GW over CC. Given the previous findings (that conservatives respond more negatively to GW relative to CC), such a propensity for using GW would have the effect of reinforcing contrarian messages on such sites. These results are consistent

with Akerlof and Maibach (2011), who found that those who reject the mainstream position on climate prefer to use GW over CC. Assessing to what extent this GW preference by contrarians is a deliberate strategy is a question that might be examined in future work. Other research has begun to examine the interaction between terminology choice and meteorological events (Schuldt and Roh 2014a, b) and the communications efficacy of terms beyond CC and GW, such as *climate crisis* and *climate disruption* (Jaskulsky and Besel 2013).

Taken together, these findings suggest that while GW might have more of an impact when communicating with known Liberal or Democratic-leaning American audiences, CC might be the optimal term when communicating to a Republican-leaning audience or audience of unknown composition. Although GW may be the more familiar term (Whitmarsh 2009), CC is both the more widely used term in the scientific literature and appears to have fewer negative connotations.

3.6 Conclusions

In this study, we examine two myths centered on the use of terminology in communicating climate change. Our results indicate that “climate change” has been used more often than *global warming* in the scientific literature and continues to be the more prevalent term in recent years. There also appears to be no relationship between the greater use of the term “global warming” (relative to *climate change*) and higher temperatures. Activist websites also seem to be continuing to use the term *global warming* into the present. Our analysis therefore leads us to conclude that the claim that the term *global warming* was abandoned in favor of the term *climate change*, in response to stalling temperature, is baseless.

Additionally, we find that *catastrophic anthropogenic global warming* is essentially a term that is never used in the relevant scientific literature by mainstream sources. Furthermore, in the press it appears to be used exclusively by climate contrarians. The term is typically neither defined nor attributed to a mainstream scientific source. Our conclusion is therefore that CAGW is simply a straw man used by climate contrarians to criticize the mainstream position. Evidence-based debunking strategies, inoculation theory, and agnotology-based learning can be employed to neutralize potential misconceptions created by such myths. Finally, we urge scientists and communicators to be mindful of the potential for confusion when using various terms relating to environmental change and to tailor their language to maximize the communications’ impact for their audiences.

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