P4.7 THE MYTH OF THE 1970S GLOBAL COOLING SCIENTIFIC CONSENSUS

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ABSTRACT

Climate science as we know it today did not exist in the 1960s and 1970s. The integrated enterprise embodied in the Nobel Prize winning work of the Intergovernmental Panel on Climate Change existed then as separate threads of research pursued by independent groups of scientists. Atmospheric chemists and modelers grappled with the measurement and understanding of carbon dioxide and other atmospheric gases while geologists and paleoclimate researchers tried to understand when Earth slipped into and out of ice ages, and why. An enduring popular myth suggests that in the 1970s the climate science community was predicting "global cooling" and an "imminent" ice age, an observation frequently used by those who would undermine what climate scientists say today about the prospect of global warming.

A review of the literature suggests that, to the contrary, greenhouse warming even then dominated scientists' thinking about the most important forces shaping Earth's climate on human time scales. More importantly than showing the falsehood of the myth, this review shows the important way scientists of the time built the foundation on which the cohesive enterprise of modern climate science now rests.

1. THE MYTH

When climate researcher Reid Bryson stood before the members of the American Association for the Advancement of Science in December 1972, his description of the state of scientists' understanding of climate change sounded very much like the old story about the group of blind men trying to describe an elephant. The integrated enterprise of climate science as we know it was in its infancy, with different groups of scientists feeling blindly around their piece of the lumbering climate beast. Rigorous measurements of increasing atmospheric carbon dioxide were available for the first time, along with modeling results suggesting global warming would be a clear consequence. Meanwhile newly created global temperature series showed cooling since the 1940s, and other scientists were looking to aerosols to explain the change. The mystery of waxing and waning ice ages had long entranced geologists, and a cohesive explanation in terms of orbital solar forcing was beginning to emerge. Underlying the discussion was a realization that climate could change on time scales with the potential for significant effects on human societies, and that human activities could trigger such changes (Bryson 1974).

Bryson laid out four questions that still stand today as central to the climate science enterprise:

(i) How large must a climate change be to be important?
(ii) How fast can the climate change?
(iii) What are the causal parameters, and why do they change?
(iv) How sensitive is the climate to small changes in the causal parameters?

Despite active efforts to answer these questions, a pervasive myth has taken hold in the public consciousness: That there was a consensus among climate scientists of the 1970s that global cooling or a full-fledged ice age was imminent (e.g., Balling 1992, Giddens 1999, Schlesinger 2003, Inhofe 2003, Will 2004, Michaels 2004, Crichton 2004, Singer and Avery

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2007, Horner 2007). A review of the climate science literature from 1965 to 1979 shows the myth to be false. The myth's basis lies in a selective misreading of the texts both by some members of the media at the time and by some observers today. In fact, emphasis on greenhouse warming dominated the scientific literature even then. The research enterprise that grew in response to the questions articulated by Bryson and others, while considering the forces responsible for cooling, quickly converged on the view that greenhouse warming was likely to dominate on time scales significant to human societies (Charney et al. 1979). But perhaps more important than demonstrating that the global cooling myth is wrong, this review shows the remarkable way in which the individual threads of climate science of the time, each group of researchers pursuing their own set of questions, was quickly woven into the integrated tapestry that created the basis for climate science as we know it today.

2. RECOGNITION OF A PROBLEM: THE POTENTIAL FOR WARMING.

When U.S. President Lyndon Johnson in 1965 asked the members of his President's Science Advisory Committee (PSAC) to report on the potential problems of environmental pollution, climate change was not on the national agenda. The polluting effects of detergents and municipal sewage, the chronic problems associated with urban air pollution, and risks associated with pesticides dominated public discourse about humanity's impact on the environment. But in a 23-page appendix that today appears prescient, the Committee's Environmental Pollution Panel laid out a stark scenario: emissions of carbon dioxide from the burning of fossil fuels could rapidly reshape Earth's climate (PSAC) 1965).

The Panel's members had two new tools at their disposal that had not been available just a few years before. The first up to date global temperature reconstructions had recently become available, allowing them to consider the 20th century's somewhat confusing temperature trends (Somerville et al. 2007). More importantly, they had access to carbon dioxide data Charles Keeling and his colleagues had been collecting since 1957 on Mauna Loa and in Antarctica (Pales and Keeling 1965, Brown and Keeling 1965). The data showed − "clearly and conclusively", in the Panel's words − that atmospheric carbon dioxide was rising as a result of fossil fuel burning. Human activities, the Panel concluded, were sufficient in scale to impact not just the immediate vicinity where those activities were taking place. Industrial activities had become a global, geophysical force to be recognized and reckoned with. With estimated recoverable fossil fuel reserves sufficient to triple atmospheric carbon dioxide, the Panel wrote, "Man is unwittingly conducting a vast geophysical experiment." With the emission of just a fraction of that, emissions by the year 2000 could be sufficient to cause "measurable and perhaps marked" climate change, the Panel concluded (PSAC 1965).

3. THE GLOBAL TEMPERATURE RECORDS: A COOLING TREND?

Efforts to accumulate and organize global temperature records began in the 1870s (Somerville et al. 2007). The first analysis to show long-term warming trends was published in 1938. But such analyses were not updated very often. Indeed, the Earth appeared to have been cooling for more than two decades when scientists first documented the change in trend in the 1960s. The seminal work was done by J. Murray Mitchell, who in 1963 published the first up-to-date temperature reconstruction showing that a global cooling trend had begun in the 1940s. Mitchell used data from nearly 200 weather stations, collected by the World Weather Records project under the auspices of the World Meteorological Organization, to calculate averaged temperatures into latitudinal bands. His analysis showed that global temperatures had increased fairly steadily from the 1880s, the start of his record, until about 1940 before the start of a steady multi-decade cooling (Mitchell 1963).

By the early 1970s, when Mitchell updated his work (Mitchell 1972), the notion of a global cooling trend was widely accepted, albeit poorly understood. The first satellite records showed increasing snow and ice cover across the northern hemisphere from the late 1960s to the early 1970s, capped by unusually severe winters in Asia and parts of North America in 1972 and 1973 (Kukla and Kukla 1974), pushed the issue into the public consciousness (Gribbin 1975). The new data about global temperatures came amid growing concerns about world food supplies, triggering fears that a planetary cooling trend might threaten humanity's ability to feed itself (Thompson 1975). It was not long, however, before scientists teasing apart the details of Mitchell's trend found that it was not necessarily a global phenomenon. A closer examination of Southern Hemisphere data showed that what appeared to be a global cooling trend was in fact dominated by Northern Hemisphere temperatures, while thermometers in the Southern Hemisphere seemed to be headed in the opposite direction (Damon and Kunen 1976).

4. ICE AGE UNDERSTANDING

While meteorologists were collecting, analyzing and trying to explain the temperature records, a largely separate group of scientists was attacking the problem from a paleoclimate perspective, assembling the first detailed understanding of the Earth's ice age history. The fact that parts of the northern hemisphere had once been covered in ice was one of the great realizations of 19th century geology. Even more remarkable was the realization that the scars on the landscape had been left by not one but several ice ages. Climate clearly was capable of remarkable variability, beyond anything humanity had experienced in recorded history.

But it was not until the mid-20th century that scientists finally assembled the details of the coming and going of the last ice ages. The geologists' classic story had suggested four short ice ages over the Quaternary, with long warm periods between them. But analysis of corals, cores from ice caps and the ocean floor, along with the application of newly developed radiometric techniques, forced a radical reevaluation. Climate was far more variable, with long ice ages punctuated by short interglacial periods (Broecker 1968, Emiliani 1972). The new work went beyond filling in gaps in scientists' knowledge of the past. It laid the foundation of an explanation for why ice age cycles happened. In 1938, Serbian engineer and geophysicist Milutin Milankovitch proposed the idea that highly regular changes in the tilt of Earth's axis and the eccentricity of its orbit around the sun could change the distribution of sunlight hitting Earth's surface, leading to the waxing and waning of ice ages. Milankovitch's work won few converts, in part because it did not match geologists' understanding of the history of the ice ages. But the new dating of the ice's ebbs and flows led to new interest in Milankovitch's ideas. "The often-discredited hypothesis of Milankovitch must be recognized as the number-one contender in the climatic sweepstakes," Wallace Broecker wrote (Broecker 1968). It took the rest of the science world a while to catch up with Broecker, but by the late 1970s they had (Hays et al. 1976, Kerr 1978, Weart 2007).

Because Milankovitch's astronomical metronome was predictable over thousands of years, climate scientists could now begin talking about predicting the onset of the next ice age. And they did. Members of the Climate: Long-rage Investigation, Mapping and Prediction project (CLIMAP) lived up to their project's name with a "prediction" of sorts: in the absence of possible anthropogenic warming, "the long-term trend over the next several thousand years is toward extensive Northern Hemisphere glaciation" (Hays et al. 1976).

5. CARBON DIOXIDE

Mid-19th century British naturalist John Tyndall was fascinated by the emerging new evidence of past ice ages, and believed he had found a possible explanation for such dramatic changes in Earth's climate − changes in the composition of the atmosphere. Some molecules, he realized, could absorb thermal radiation, and as such could be the cause for "all the mutations of climate which the researches of geologists reveal" (Weart 2007, Tyndall 1861, as quoted in Somerville et al. 2007). Swedish scientist Svante Arrhenius, in 1896, calculated that a doubling of atmospheric carbon dioxide would raise global temperatures 5–6ºC. But he figured it would take three thousand years of fossil fuel burning to do it (Weart 2007). Thus continued what would be a century of scientific debate and uncertainty, both about the effect of such so-called "greenhouse gases" and the possibility that the burning of fossil fuels could contribute substantially to their concentration (Landsberg 1970). It was not until the second half of the 20th century that scientists finally had the tools to begin measuring the concentrations of those greenhouse gases in sufficient detail to begin evaluating their effects.

Using funding available through the International Geophysical Year, Charles Keeling was able to overcome problems of local interference in carbon dioxide measurements in 1957 by establishing stations in Antarctica and atop Mauna Loa. By 1965, his data were sufficient to show an unambiguous trend. Keeling's observations also showed that atmospheric carbon dioxide was increasing far faster than Arrhenius's 70-year-old estimate. That was enough for members of the U.S. President's Scientific Advisory Committee to pronounce the possibility that increasing carbon dioxide could "modify the heat balance of the atmosphere to such an extent that marked changes in climate, not controllable through local or even national efforts, could occur" (PSAC 1965).

The PSAC scientists had a new tool for understanding the implications − the first preliminary results of newly developing climate models. The same year the PSAC report came out, Syukuro Manabe and Richard Wetherald published the first true three-dimensional climate model. The results were raw at the time the PSAC report was written. But within two years, the first seminal modeling results from the Geophysical Fluid Dynamics Laboratory team were published. Given their simplifying constraints, they found a doubling of atmospheric carbon dioxide would raise global temperature 2ºC (Manabe and Wetherald 1967). Within a decade, the models' sophistication had grown dramatically, enough for Manabe and Wetherald to conclude that high latitudes were likely to see greater warming in a doubled-CO_2 world, and that the intensity of the hydrologic cycle could be expected to increase significantly (Manabe and Wetherald 1975). The accumulating evidence of the new carbon dioxide record and the modeling results was enough for Wallace Broecker to ask in 1975: "Are we on the brink of a pronounced global warming?" Broecker's answer was a resounding "yes" (Broecker 1975).

6. AEROSOLS

In December 1968, a group of scientists convened in Dallas for a "Symposium on Global Effects of Environmental Pollution" (Singer 1970). Reid Bryson showed the panel a remarkable graph showing the correlation between rising levels of dust in the Caucasus and the rising output of the Russian economy over the previous three decades. It was the foundation for an argument leading from human activities to dust to changing climate. Atmospheric pollution caused by humans was sufficient, Bryson argued, to explain the decline in global temperatures identified earlier in the decade by J. Murray Mitchell (Bryson and Wendland 1970).

Also on the symposium panel was Mitchell himself, and he disagreed. Mitchell's calculations suggested that particulates added to the atmosphere were insufficient to explain the cooling seen in his temperature records. But he raised the possibility that, over time, cooling caused by particulates could overtake warming caused by what he called "the CO_2 effect" (Mitchell 1970).

S. Ichtiaque Rasool and Stephen Schneider in 1971 wrote what may be the most misinterpreted and misused paper in the story of global cooling (Rasool and Schneider 1971). It was the first foray into climate science for Schneider, who would become famous for his work on climate change. Rasool and Schneider were trying to extend the newly developing tool of climate modeling to include the effects of aerosols, in an attempt to sort out two potentially conflicting trends − the warming brought about by increasing carbon dioxide and the cooling potential of aerosols emitted into Earth's atmosphere by industrial activity.

The answer proposed by Rasool and Schneider to the questions posed by Bryson and Mitchell's disagreement was stark. An increase by a factor of four in global aerosol concentrations − "which cannot be ruled out as a possibility" − could be enough to trigger an ice age (Rasool and Schneider 1971). Critics quickly pointed out flaws in Rasool and Schneider's work, including some they acknowledged themselves (Charlson et al. 1972, Rasool and Schneider 1972). Refinements, using data on aerosols from volcanic eruptions, showed that while cooling could result, the original Rasool and Schneider paper had overestimated cooling while underestimating the greenhouse warming contributed by carbon dioxide (Schneider and Mass 1975, Weart 2007). Adding to the confusion at the time, other researchers concluded that aerosols would lead to warming rather than cooling (Reck 1975, Idso and Brazel 1977).

It was James Hansen and his colleagues who found what seemed to be the right balance between the two competing forces by modeling the aerosols from Mount Agung, a volcano that erupted in Bali in 1963. Hansen and his colleagues fed data from the Agung eruption into their model, which got the size and timing of the resulting pulse of global cooling correct. By 1978, the question of the relative role of aerosol cooling and greenhouse warming had been sorted out. Greenhouse warming, the researchers concluded, was the dominant forcing (Hansen et al. 1978, Weart 2007).

7. MEDIA COVERAGE

When the myth of the 1970s global cooling scare arises in contemporary discussion over climate change, it is most often in the form of citations not to the scientific literature, but to news media coverage. That is where U.S. Senator James Inhofe turned for much of the evidence to support his argument in a Senate floor speech in 2003 (Inhofe 2003). Chief among his evidence was a frequently cited *Newsweek* story: "The Cooling World" (Gwynne 1975). The story drew from the latest global temperature records, and suggested that cooling "may portend a drastic decline for food production." Citing the Kuklas' work on increasing northern hemisphere snow and ice, and Reid Bryson's concerns about a long term cooling trend, the *Newsweek* story contrasts the possibility of cooling temperatures and decreasing food production with rising global populations. Other articles of the time featured similar themes (*Time* 1974, Mathews 1976).

But an even cursory review of the news media coverage of the issue reveals that, just as there was no consensus at the time among scientists, so was there also no consensus among journalists. For example, these are titles from two *New York Times* articles: "Scientists ask why world climate is changing; major cooling may be ahead" (Sullivan, 1975a) and "Warming trend seen in climate; two articles counter view that cold period is due" (Sullivan, 1975b). Additionally, the book *The Cooling* (Ponte 1976) was published the year after the book *Hothouse Earth* (Wilcox 1975).

However, the news coverage of the time does reflect what *New York Times* science writer Andrew Revkin calls "the tyranny of the news peg," based on the idea that reporters need a "peg" on which to hang a story. Developments that are dramatic or new tend to draw the news media's attention, Revkin argues, rather than the complexity of a nuanced discussion within the scientific community (Revkin 2005). A handy peg for climate stories during the 1970s was the cold weather.

8. SURVEY OF THE PEER-REVIEWED LITERATURE.

Given that media representations do not capture the full scope of the scientific literature of the time, we conducted a rigorous literature review of the *American Meteorological Society*'s electronic archives as well as those of *Nature* and the scholarly journal archive *Journal Storage* (JSTOR). To capture the relevant topics, we used global temperature, global warming and global cooling as well as a variety of other less directly relevant search terms. Additionally, in order to make the survey more complete, even at the expense of no longer being fully reproducible by electronic search techniques, many references mentioned in the papers located by these searches were evaluated as were references mentioned in various history of science documents. As the time period attributed to the global cooling consensus is typically described as the 1970s, the literature search was limited to the period from 1965 through 1979. While no search can be 100% complete, the methodology offers a reasonable test of the hypothesis that there was a scientific consensus in the 1970s regarding the prospect of imminent global cooling. Such a consensus would be easily shown by both the presence of many articles describing global cooling projections and the absence of articles projecting global warming.

One measure of the relevance of a paper to a developing scientific consensus is the number citations it receives. For that reason, a citation analysis of the papers found in our survey was undertaken. Not all the citations may be supportive of the paper in question, but they do help indicate which papers dominated the thinking of the day. As the period assessed ended in 1979 and it takes time for citations to start appearing, the citation count was extended through 1983. The gray literature of conference proceedings were not authoritative enough to include in the literature search. However, a few prestigious reports that may not have been peer-reviewed have been included in this literature survey as they clearly represent the science of their day.

Our literature survey was limited to those papers projecting climate change on, or even just discussing an aspect of climate forcing relevant to, time scales of decades to a century. While some of these articles make clear predictions of global surface temperature change by the year 2000, most of these articles do not. Many of the articles simply examined some aspect of climate forcing. However, it was generally accepted that both CO_2 and anthropogenic aerosols were increasing. Therefore, for example, articles that estimated temperature increases resulting from doubling CO_2 or temperature decreases due to anthropogenic aerosols would be listed in Table 1 as warming or cooling articles, respectively. The neutral category in Table 1 includes papers that project no change, that discuss both warming and cooling influences without specifically indicating which are likely to be dominant, or that state not enough is known to make a sound prediction. Articles were not included in the survey if they examined the climate impacts of factors that did not have a clear expectation of imminent change such as increases in volcanic eruptions or the creation of large fleets of supersonic transports.

The survey identified only seven articles indicating cooling compared to 42 indicating warming. Those seven cooling articles garnered just 12% of the citations. Graphical representations of this survey are shown in Figure 1 for the number of articles and Figure 2 for the number of citations. Interestingly, only two of the articles would, according to the current state of climate science, be considered wrong in the sense of getting the wrong sign of the response to the forcing they considered. They are one cooling paper (Bryson and Dittberner, 1976) and one warming paper (Idso and Brazel, 1977) and both were immediately challenged (Woronko 1977, Herman et al. 1978). As climate science and the models progressed over time, the findings of the rest of the articles were refined and improved, sometimes significantly, but not reversed.

Given that even a cursory examination of Figure 1 reveals that global cooling was never more than a minor aspect of the scientific climate change literature of the era, let alone the scientific consensus, it is worth examining the ways in which the global cooling myth persists. One involves the simple misquoting of the literature. In a 2003 *Washington Post* op-ed piece, former Energy Secretary James Schlesinger quoted a 1972 National Science Board report as saying: “Judging from the record of the past interglacial ages, the present time of high temperatures should be drawing to an end...leading into the next glacial age” (Schlesinger 2003). The quote repeatedly appeared other places in the political debate over climate change, including the floor of the United States Senate where Senator Inhofe (2003) followed up that quote by stating, “That was the same timeframe that the global-warming alarmists are concerned about global warming.” The actual report, however, shows that the original context, rather than supporting the global cooling myth, discusses the full state of the science at the time, as described earlier. The words not extracted by Schlesinger and Inhofe are highlighted with italics.

> Judging from the record of the past interglacial ages, the present time of high temperatures should be drawing to an end, *to be followed by a long period of considerably colder temperatures* leading to the next glacial age *some 20,000 years from now. However, it is possible, or even likely, that human interference has already altered the environment so much that the climatic pattern of the near future will follow a different path. For instance, widespread deforestation in recent centuries, especially in Europe and North America, together with increased atmospheric opacity due to man-made dust storms and industrial wastes, should have increased the Earth’s reflectivity. At the same time increasing concentration of industrial carbon dioxide in the atmosphere should lead to a temperature increase by absorption of infrared radiation from the Earth’s surface. When these human factors are added to such other natural factors as volcanic eruptions, changes in solar activity, and resonances within the hydro-atmosphere, their effect can only be estimated in terms of direction, not of amount* (National Science Board 1972).

Underlying the selective quotation of the past literature is an example of what political scientist Daniel Sarewitz calls “scientization” of political debate: the selective emphasis on particular scientific “facts” to advance a particular set of political values (Sarewitz 2004). In this case, the primary use of the myth is in the context of attempting to undermine public belief in and support for the contemporary scientific consensus about anthropogenic climate change by appeal to a past “consensus” on a closely related topic that is alleged to have been wrong (e.g., Balling 1992, Giddens 1999, Schlesinger 2003, Inhofe 2003, Will 2004, Michaels 2004, Crichton 2004, Singer and Avery 2007, Horner 2007).

9. INTEGRATING CLIMATE SCIENCE IN THE LATE 1970s.

When James D. Hays and colleagues published their landmark 1976 paper linking variations in Earth’s orbit to the ice ages, they offered two caveats: “Such forecasts must be qualified in two ways. First, they apply only to the natural component of future climatic trends − and not to anthropogenic effects such as those due to the burning of fossil fuels. Second, they describe only the long-term trends, because they are linked to orbital variations with periods of 20,000 years and longer. Climatic oscillations at higher frequencies are not predicted” (Hays et al. 1976).

It was a common reaction in climate science at the time. As the various threads of climate research came together in the late 1970s into a unified field of study − ice ages, aerosols, greenhouse forcing and the global temperature trend − greenhouse forcing was coming to be recognized as the dominant term in the climate change equations for timescales from decades to centuries. That was the message from B.J. Mason of the British Meteorological Office when he stood before members of the Royal Society in London on April 27, 1978, to deliver a review lecture on the state of the science. Taking his audience through the details of how the new computer climate models worked and what they showed, Mason ticked off a now-familiar list of climate variables: variations in Earth's orbit, aerosols and the rapid increase in greenhouse gases. The effect of the latter, he said, was by far the largest, and more detailed study of the issue "now deserves high priority" (Mason 1978b).

The threads came together most famously in a meeting held in July 1979 in Woods Hole. There, Jule Charney, one of the pioneers of climate modeling, brought together a panel of experts under the U.S. National Research Council to sort out the state of the science. The Charney panel's work has become iconic as a foundation for the enterprise of climate change study that followed (Somerville et al. 2007). Such reports are a traditional approach within in the United States for eliciting expert views on scientific questions of political and public policy importance (Weart 2007). In this case, the Charney panel concluded that the potential damage from greenhouse gases was real and should not be ignored. The potential for cooling, the threat of aerosols, or the possibility of an ice age shows up nowhere in the report. Warming from doubled CO_2 of 1.5 to 4.5ºC was possible, the panel reported. While there were huge uncertainties, Verner Suomi, chairman of the National Research Council's Climate Research Board wrote in the report's foreword that he believed there was enough evidence to support action: "A wait-and-see policy may mean waiting until it is too late" (Charney et al. 1979). Clearly if a national report in the 1970s advocates urgent action to address global warming, then the scientific consensus of the 1970s was not global cooling.

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Table 1. Cooling papers, Neutral papers and Warming Papers as defined in the text followed by the number of times they have been cited up through 1983.

Year	Cooling papers	Neutral papers	Warming papers
1965			President's Science Advisory Committee 1965-66
1966			
1967	McCormick and Ludwig 1967-67		Manabe and Weatherald 1967-306
1968			
1969			Sellers 1969-191
1970		Landsberg 1970-83	Benton 1970-0, Report of the Study of Critical Environmental Problems 1970-130
1971	Barrett 1971-14, Rasool and Schneider 1971-144		Mitchell 1971-81
1972	Hamilton and Seliga 1972-12	Charlson et al. 1972-0, Lowry 1972-0, National Science Board 1972-0, Rasool and Schneider 1972-0,	Budyko 1972-36, Machta 1972-31, Mitchell 1972-36, Sawyer 1972-8
1973		Sellers 1973-104	
1974	Chýlek and Coakley 1974-38	Bryson 1974-113, Hobbs et al. 1974-22, Weare et al. 1974-12	Federal Council for Science and Technology Interdepartmental Committee for Atmospheric Sciences 1974-1, Kellogg and Schneider 1974-30, Sellers 1974-33
1975		National Academy of Sciences 1975-0	Broecker 1975-54, Manabe and Wetherald 1975-211, Ramanathan 1975-63, Reck 1975-13, Schneider and Mass 1975-82, Schneider 1975-94, Thompson 1975-49,
1976	Bryson and Dittberner 1976-31	Shaw 1976-6	Budyko and Vinnikov 1976-0, Damon and Kunen 1976-29, Mitchell 1976-50, Wang et al. 1976-89
1977	Twomey 1977-19	Bryson and Dittberner 1977-0	Idso and Brazel 1977-1, Lee and Snell 1977-8, National Academy of Sciences 1977-1, Nordhaus 1977-13, Woronko 1977-1
1978		Herman et al. 1978-0, Mason 1978a-0, Miles 1978-8, Ramanathan and Coakley 1978-44, Shutts and Green 1978-3	Budyko et al. 1978-0, Cooper 1978-0, Gilchrist 1978-5, Idso and Brazel 1978-2, Mason 1978b-0, Mercer 1978-48, Ohring and Adler 1978-25, Stuiver 1978-101
1979		Choudhury and Kukla 1979-4, Sagan et al. 1979-25	Berger 1979-6, Charney et al. 1979-50, Houghton 1979-0, Hoyt 1979-13, Rotty 1979-1

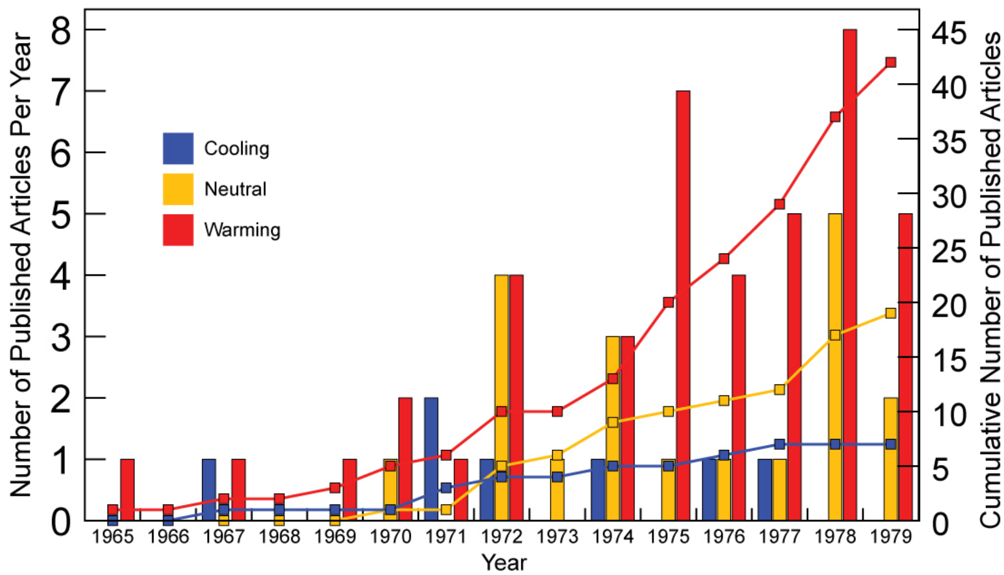

Figure 1. The number of papers classified as predicting, implying or providing supporting evidence for future global cooling, warming and neutral categories as defined in the text and listed in Table 1. During the period 1965 through 1979, our literature survey found 7 cooling papers, 19 neutral and 42 warming. In no year were there more global cooling papers than global warming.

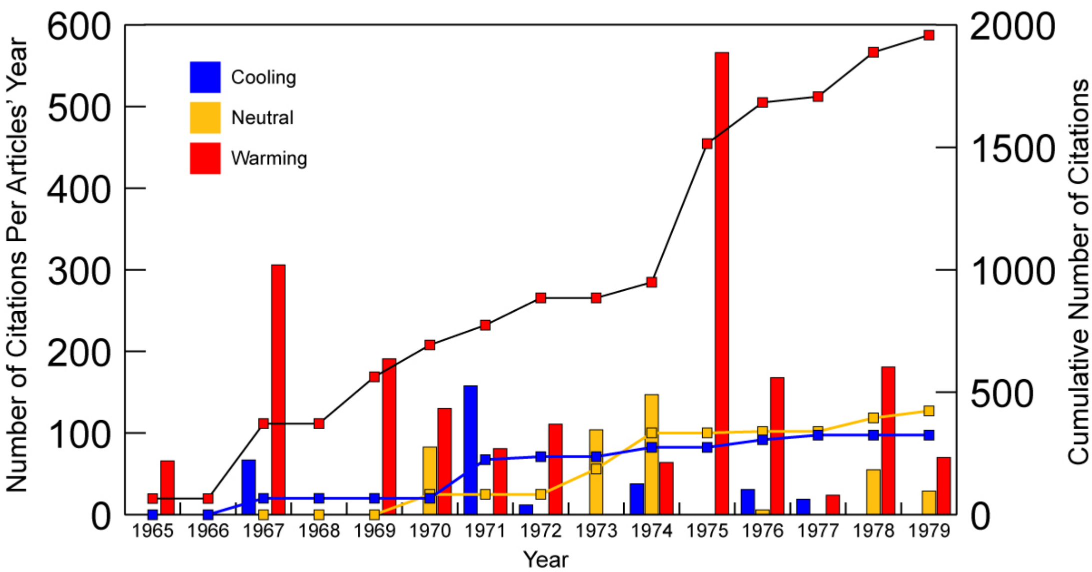

Figure 2. The number of citations for the articles shown in Figure 1 and listed in Table 1. The citation counts were from the publication date through 1983 and are graphed on the year the article was published. The cooling papers received a total of 325 citations, neutral 424 and warming 1958.