# Is there a basis for global warming alarm?

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For the sensitive reader or listener, the language used in connection with the issue of Global Warming must frequently sound strange. Weather and climate catastrophes of all sorts are claimed to be what one expects from global warming, and global warming is uniquely associated with man's activities. The reality of the threat of global warming is frequently attested to by reference to a scientific consensus:

Tony Blair: "The overwhelming view of experts is that climate change, to a greater or lesser extent, is man-made, and, without action, will get worse."

Elizabeth Kolbert in *New Yorker*[1]: "All that the theory of global warming says is that if you increase the concentration of greenhouse gases in the atmosphere, you will also increase the earth's average temperature. It's indisputable that we have increased greenhouse-gas concentrations in the air as a result of human activity, and it's also indisputable that over the last few decades average global temperatures have gone up."

Given the alarm that surrounds the issue, such statements seem peculiarly inconclusive and irrelevant to the catastrophes cited. To be sure, these references are one-sided. They fail to note that there are many sources of climate change, and that profound climate change occurred many times both before and after man appeared on earth; given the ubiquity of climate change, it is implausible that all change is for the worse. Moreover, the coincidence of increasing $CO_2$ and the small warming over the past century hardly establishes causality. Nevertheless, for the most part I do not personally disagree with the Consensus (though the absence of any quantitative considerations should be disturbing). Indeed, I know of no serious split, and suspect that the claim that there is opposition to this consensus amounts to no more than setting up a straw man to scoff at. However, I believe that people are being led astray by the suggestion this agreement constitutes support for alarm.

Let us view the components that comprise this consensus a little more precisely while recognizing that there is, indeed, some legitimate controversy connected with specific aspects of even these items.

1. The global mean surface temperature is always changing. Over the past 60 years, it has both decreased and increased. For the past century, it has probably increased by about 0.6 ±0.15 degrees Centigrade (C). That is to say, we have had some global mean warming.

2. $CO_2$ is a greenhouse gas and its increase should contribute to warming. It is, in fact, increasing, and a doubling would increase the greenhouse effect (mainly due to water vapor and clouds) by about 2%.

3. There is good evidence that man has been responsible for the recent increase in $CO_2$, though climate itself (as well as other natural phenomena) can also cause changes in $CO_2$.

In some respects, these three pillars of consensus are relatively trivial. Remaining completely open is the question of whether there is any reason to consider this basic agreement as being alarming. Relatedly, is there any objective basis for considering the approximate 0.6C increase in global mean surface temperature to be large or small regardless of its cause? The answer to both questions depends on whether 0.6C is larger or smaller than what we might have expected on the basis of models which have led to our concern. These models are generally called General Circulation Models (GCMs). We may, therefore, seek to determine how the current level of man made climate forcing compares with what we would have were $CO_2$ to be doubled (a common reference level for GCM calculations).

In terms of climate forcing, greenhouse gases added to the atmosphere through mans activities since the late 19th Century have already produced three-quarters of the radiative forcing that we expect from a doubling of $CO_2$[2]. The main reasons for this are

1) $CO_2$ is not the only anthropogenic greenhouse gas - others like methane also contribute; and

2) The impact of $CO_2$ is nonlinear in the sense that each added unit contributes less than its predecessor. For example, if doubling $CO_2$ from its value in the late 19$^{th}$ Century (about 290 parts per million by volume or ppmv) to double this (i.e., 580 ppmv) causes a 2% increase in radiative forcing[3], then to obtain another 2% increase in radiative forcing we must increase $CO_2$ by an additional 580 ppmv rather than by another 290 ppmv. At present, the concentration of $CO_2$ is about 380 ppmv. The easiest way to understand this is to consider adding thin layers of paint to a pane of glass. The first layer cuts out much of the light, the next layer cuts out more, but subsequent layers do less and less because the painted pane is already essentially opaque.

It should be stressed that we are interested in climate forcing, and not simply levels of $CO_2$; the two are most certainly not linearly proportional.

Essential to alarm is the fact that most current climate models predict a response to a doubling of $CO_2$ of about 4C (which is much larger than what one expects the simple doubling of $CO_2$ to produce: ie, about 1C). The reason for this is that in these models, the most important greenhouse substances, water vapor and clouds, act in such a way as to greatly amplify the response to anthropogenic greenhouse gases alone (ie, they act as what are called large positive feedbacks). However, as all assessments of the Intergovernmental Panel on Climate Change (IPCC) have stated (at least in the text – though not in the Summaries for Policymakers), the models simply fail to get clouds

right. We know this because in official model intercomparisons, all models fail miserably to replicate observed distributions of cloud cover. Thus, the model predictions are critically dependent on features that we know must be wrong. In Figure 1 we see that treatment of clouds involves errors an order of magnitude greater than the forcing from a doubling of $CO_2$[4]. While the IPCC allows for the possibility that the models get water vapor right, the intimate relation of water vapor to clouds makes such a conclusion implausible.

**Figure 1. Each thin gray line shows an individual model's hindcast of percentage cloud cover averaged by latitude. The black line shows the observed cloud cover.**

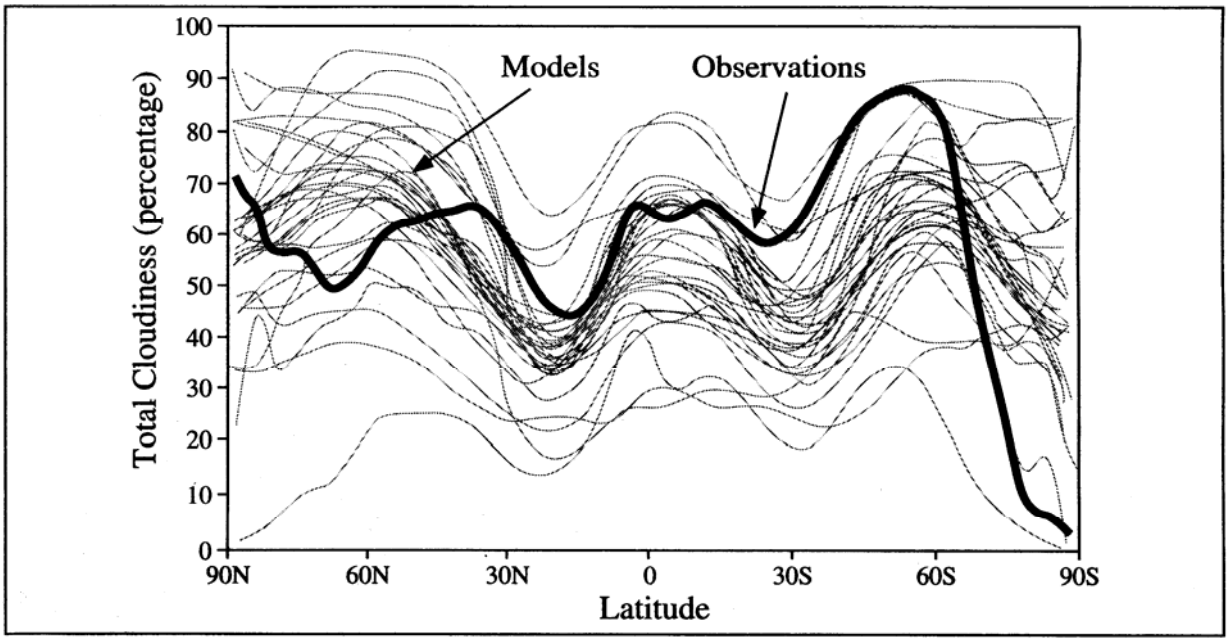


**Figure 1**

Let me summarize the main points thus far:

1. It is NOT the level of $CO_2$ that is important, but rather the impact of man made greenhouse gases on climate.

2. Although we are far from the benchmark of doubled $CO_2$, climate forcing is already about 3/4 of what we expect from such a doubling.

3. Even if we attribute all warming over the past century to man made greenhouse gases (which we have no basis for doing), the observed warming is only about 1/3-1/6 of what models project. We are logically led to two possibilities:

1. Our models are greatly overestimating the sensitivity of climate to man made greenhouse gases, or
2. The models are correct, but there is some unknown process that has cancelled most of the warming.

Note that calling the unknown process “aerosols” does not change this statement since aerosols and their impact are unknown to a factor of ten or more; indeed, even the sign is in doubt.

In arguing for climate alarmism, we are choosing the second possibility. Moreover, we are assuming that the unknown cancellation will soon cease. How is the second possibility supported given that it involves so many more assumptions than the first possibility?

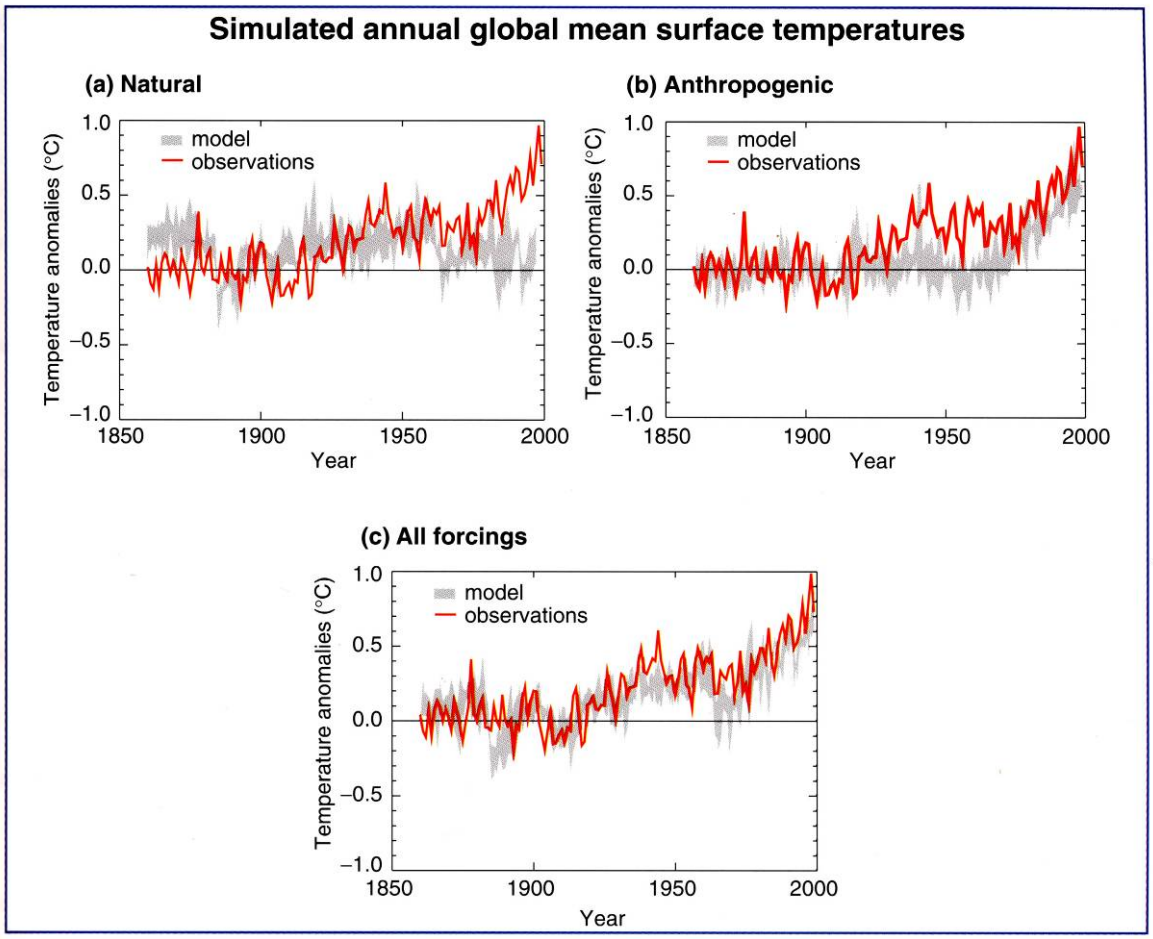


**Figure 2 Simulations of global mean temperature with various combinations of ‘forcing.’**

The IPCC Third Assessment Report (TAR) made use of a peculiar exercise in curve fitting using results from the Hadley Centre. It consists in three plots which are reproduced in Figure 2. In the first panel, we are shown an observed temperature record (without error bars), and the outputs of four model runs (using their coupled ocean-atmosphere model) with so-called natural forcing for the period 1860-2000. There is a small spread in the model runs (which presumably displays model uncertainty – it most assuredly does not represent natural internal variability). In any event, the models look roughly like the observations until the last 30 years. We are then shown a second diagram where the observed curve is reproduced and the four models are run with anthropogenic forcing. Here we see rough agreement over the last 30 years, and poorer

agreement in the earlier period. Finally, we are shown the observations and the model runs with both natural and anthropogenic forcing, and, *voila*, there is rough agreement over the whole record. It should be noted that the models used had a relatively low sensitivity to a doubling of $CO_2$ of about 2.5C.

In order to know what to make of this exercise, one must know exactly what was done. The natural forcing consisted in volcanoes and solar variability. Prior to the Pinatubo eruption in 1991, the radiative impact of volcanoes was not well measured, and estimates vary by about a factor of 3. Solar forcing is essentially unknown. Thus, natural forcing is, in essence, adjustable. Anthropogenic forcing includes not only anthropogenic greenhouse gases, but also aerosols that act to cancel warming (in the Hadley Centre outputs, aerosols and other factors cancelled two thirds of the greenhouse forcing). Unfortunately, the properties of aerosols are largely unknown. In the present instance, therefore, aerosols constitute simply another adjustable parameter (indeed, both its magnitude and its time history are adjustable, and even its sign is in question). This was remarked upon in a recent paper in *Science* (Andersen, et al, 2003[5]), wherein it was noted that the uncertainty was so great that estimating aerosol properties by tuning them to optimize agreement between models and observations (referred to as an inverse method) was probably as good as any other method, but that the use of such estimates to then test the models constituted a circular procedure. This is as strong a criticism of model procedures as is likely to be found in *Science*. The authors are all prominent in aerosol work. The first author is the most junior, and when it was pointed out that the article reflected negatively on model outputs, he vehemently denied any such intent. In the present example, the choice of models with relatively low sensitivity, allowed adjustments that were not so extreme.

New uncertainties are always entering the aerosol picture. Some are quite bizarre. A recent article in *Science* (Jaenicke, 2005[6]) even proposed a significant role to airborn dandruff. Other articles have been suggesting that the primary impact of aerosols is actually warming (Jacobson, 2001[7], Chen and Penner, 2005[8]). Of course this is the beauty of the global warming issue for many scientists. The issue deals with such small climate forcing and small temperature changes that it permits scientists to argue that everything and anything is important for climate.

In brief, the defense of the models starts by assuming the model is correct. One then attributes differences between the model behavior in the absence of external forcing, and observed changes in 'global mean temperature' to external forcing. Next one introduces 'natural' forcing and tries to obtain a 'best fit' to observations. If, finally, one is able to remove remaining discrepancies by introducing 'anthropogenic' forcing, we assert that the attribution of part of the observed change to the greenhouse component of 'anthropogenic' forcing must be correct.

Of course, model internal variability is not correct, and 'anthropogenic' forcing includes not only $CO_2$ but also aerosols, and the latter are unknown to a factor of 10-20 (and perhaps even sign). Finally, we have little quantitative knowledge of 'natural' forcing so

this too is adjustable. Recall that the Hadley Centre acknowledges that the "aerosols" cancelled most of the forcing from $CO_2$.

Yet, the 'argument' I have just presented is the basis for all popular claims that scientists now 'believe' that man is responsible for much of the observed warming! It would appear that the current role of the scientist in the global warming issue is simply to defend the 'possibility' of ominous predictions so as to justify his 'belief.'

To be fair to the authors of Chapter 12 of the IPCC Third Scientific Assessment here is what they provided for the draft statement of the Policymakers Summary: *From the body of evidence since IPCC (1996), we conclude that there has been a discernible human influence on global climate. Studies are beginning to separate the contributions to observed climate change attributable to individual external influences, both anthropogenic and natural. This work suggests that anthropogenic greenhouse gases are a substantial contributor to the observed warming, especially over the past 30 years. However, the accuracy of these estimates continues to be limited by uncertainties in estimates of internal variability, natural and anthropogenic forcing, and the climate response to external forcing.*

This statement is not too bad – especially the last sentence. To be sure, the model dependence of the results is not emphasized, but the statement is vastly more honest than what the Summary for Policymakers in the IPCC's Third Assessment Report ultimately presented:

*In the light of new evidence and taking into account the remaining uncertainties, most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations.*

In point of fact, the impact of man remains indiscernible simply because the signal is too small compared to the natural noise. Claims that the current temperatures are 'record breaking' or 'unprecedented', however questionable or misleading, simply serve to obscure the fact that the observed warming is too small compared to what models suggest. Even the fact that the oceans' heat capacity leads to a delay in the response of the surface does not alter this conclusion (especially since the Hadley Centre results are obtained with a coupled model).

Moreover, the fact that we already have three quarters of the climate forcing expected from a doubling of $CO_2$ means that if one truly believes the models, then we have long since passed the point where mitigation is a viable strategy. What remains is to maximize our ability to adapt. That the promotion of alarm does not follow from the science is clearly illustrated by the following example:

According to any textbook on dynamic meteorology, one may reasonably conclude that in a warmer world, extratropical storminess and weather variability will actually decrease. The reasoning is as follows. Judging by historical climate change, changes are greater in high latitudes than in the tropics. Thus, in a warmer world, we would expect

that the temperature difference between high and low latitudes would diminish. However, it is precisely this difference that gives rise to extratropical large-scale weather disturbances. Moreover, when in Boston on a winter day we experience unusual warmth, it is because the wind is blowing from the south. Similarly, when we experience unusual cold, it is generally because the wind is blowing from the north. The possible extent of these extremes is, not surprisingly, determined by how warm low latitudes are and how cold high latitudes are. Given that we expect that high latitudes will warm much more than low latitudes in a warmer climate, the difference is expected to diminish, leading to less variance.

Nevertheless, we are told by advocates and the media that exactly the opposite is the case, and that, moreover, the models predict this (which, to their credit, they do not) and that the basic agreement discussed earlier signifies scientific agreement on this matter as well. Clearly more storms and greater extremes are regarded as more alarming than the opposite. Thus, the opposite of our current understanding is invoked in order to promote public concern. The crucial point here is that once the principle of consensus is accepted, agreement on anything is taken to infer agreement on everything advocates wish to claim.

The reader may have noticed that I focused on extratropical storms in the above example. However, given the relatively heavy hurricane season we've had, the emphasis of late has been on tropical storms. Recent papers suggesting that in a warmer world, such storms may become more powerful[9], have been seized upon with alacrity by political activists. Needless to add, the articles seized upon have been extremely controversial, but more to the point, no such relation was uncovered for storms reaching land – only for those over water.

At this point, it is doubtful that we are even dealing with a serious problem. If this is correct, then there is no policy addressing this non-problem that would be cost-effective. Even if we believe the problem to be serious, we have already reached the levels of climate forcing that have been claimed to be serious. However, when it comes to Kyoto, the situation is even worse. Here, there is widespread and even rigorous scientific agreement that complete adherence to the Kyoto Agreement would have no discernible impact on climate regardless of what one believes about climate. Thus, the theme of this meeting is, at least on this count, appropriate.

What about the first possibility: namely that the models on which we are basing our alarm are much too sensitive? Not only is this the possibility that scientists would normally have preferred on the basis of Occam's famous razor, but it is also a possibility for which there is substantial support[10]. I will focus on one line of this evidence: tropical warming in the 90's has been associated with much greater outgoing long wave radiation than models produce. This discrepancy points toward the absence of a strong negative feedback in current models.

The discrepancy has been confirmed by at least four independent groups: at NASA's Goddard Institute for Space Studies (Chen et al, 2002, DelGenio and Kovari, 2002[11]), at

NASA Langley (Wielicki et al, 2002, Lin et al, 2004[12]), at SUNY Stony Brook (Cess and Udelhofen, 2003[13]), and at the University of Miami (Clement and Soden, 2005[14]).

This discrepancy would normally have pointed to exaggerated model sensitivity. However, the preceding papers attempted to either attribute the discrepancy to circulation changes or to 'unknown' cloud properties – except for the last paper. Clement and Soden (2005) showed that changes in dynamics could not produce changes averaged over the tropics. They showed this using 4 separate models, but it had been shown theoretically by Chou and Lindzen (2004)[15] Clement and Soden also showed that the discrepancy could be resolved by allowing convective precipitation efficiency to increase with surface temperature. Such a dependence is at the heart of the iris effect which was first found by Lindzen, Chou and Hou (2001)[16], and was theoretically predicted by Sun and Lindzen (1993)[17]. In LCH, we attempted to examine how tropical clouds responded to changing surface temperature, and found that existing satellite data was only marginally capable of dealing with this issue. The results, however, suggested that there were strong negative feedbacks -- counter to what models suggest. It was moreover, easy to show that models in no way replicated the cloud behavior that was observed.

It may turn out that the rigorous measurement of precipitation can be done with ground based radar. Ground based radar allows the almost continuous measurement of precipitation and the separation of convective precipitation from stratiform precipitation (albeit with remaining questions of accuracy). In the tropics, both types of precipitation originate in condensation within cumulus towers. However, condensation that does not form precipitation is carried aloft as ice which is detrained to form cirrus from which the condensate eventually falls as stratiform precipitation. Precipitation efficiency is given by the relation

$$e = \frac{\text{convective precipitation}}{\text{convective precipitation + stratiform precipitation}}$$

Using data from Kwajalein Atoll in the western Pacific, we were able to study how *e* varies with sea surface temperature. In addition, the Kwajalein radar allows one

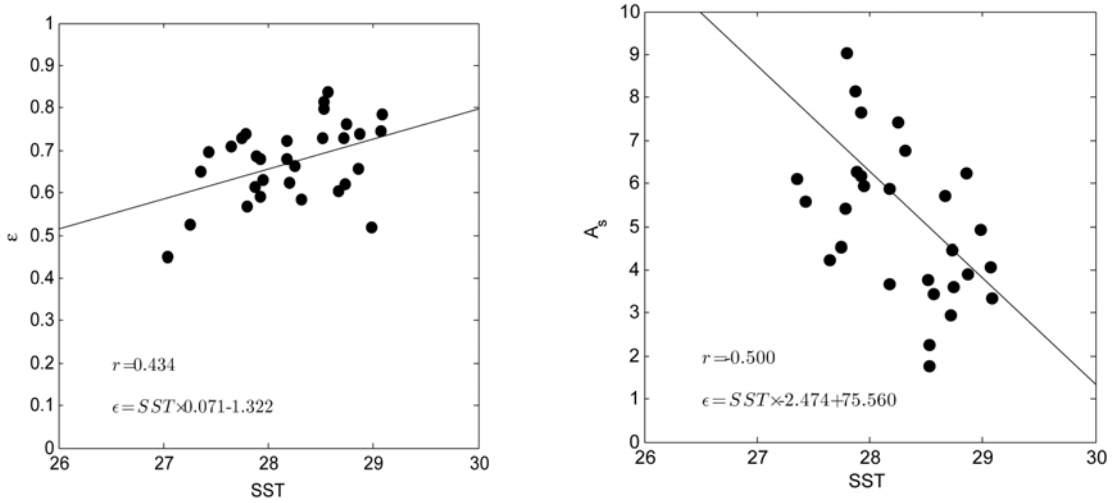


**Figure 3 Left: Precipitation efficiency v. surface temperature; Right: Cirrus area per unit convective activity v. surface temperature.**

to explicitly look at the area of stratiform rain per unit of convective mass flux.

We see from Figure 3 that *e* increases about 7.1% per degree C increase in SST (compared with 7.5% estimated by Sun and Lindzen, 1993), and that this increase is associated with a decrease in normalized stratiform area of about 25% per degree C (which is a bit larger than what was estimated from space observations by Lindzen, Chou and Hou, 2001). If correct, this basically confirms the iris effect, and the fact that models have greatly exaggerated climate sensitivity because, in contrast to models, nature, itself, acts to limit rather than exaggerate the influence of added greenhouse gases.

What would be the implication of these simple results?

The primary implication would be that for over 25 years, we have based not only our worst case scenarios but even our best case scenarios on model exaggeration. This was already suggested by previous results, but the present result has the virtue of specifically identifying a basic and crucially relevant error. Under the circumstances, the main question we will be confronting is how long the momentum generated by this issue will prevent us from seeing that it has been an illusion based on model error. However, I am not altogether optimistic about this.

The public discourse on global warming has little in common with the standards of scientific discourse. Rather, it is part of political discourse where comments are made to secure the political base and frighten the opposition rather than to illuminate issues. In political discourse, information is to be "spun" to reinforce pre-existing beliefs, and to discourage opposition. The chief example of the latter is the perpetual claim of universal scientific agreement. This claim was part of the media treatment of global cooling (in the 1970's) and has been part of the treatment of global warming since 1988 (well before most climate change institutes were created). The consensus preceded the research.

That media discourse on climate change is political rather than scientific should, in fact, come as no surprise. However, even scientific literature and institutions have become politicized. Some scientists issue meaningless remarks in what I believe to be the full expectation that the media and the environmental movement will provide the 'spin.' Since the societal response to alarm has, so far, been to increase scientific funding, there has been little reason for scientists to complain. Should scientists feel any guilt it is assuaged by two irresistible factors: The advocates define public virtue; and administrators are delighted with the growing grant overhead. The situation has been recognized since time immemorial. In Federalist Paper No. 79, Alexander Hamilton brooded about abuses that might arise from legislative tampering with judges' salaries. "In the general course of human nature," he wrote, "a power over a man's subsistence amounts to a power over his will." An indication of such an attitude occurred when, in 2003, the draft of the US National Climate Plan urged high priority for improving our knowledge of climate sensitivity (ie, in finding the answer). It appears that an NRC review panel was critical of this prioritization, urging prioritization instead for broader support for numerous groups to study the impacts of the putative warming. One is

tempted to suggest that the NRC panel was more interested in spreading the wealth than in finding an answer.

A second aspect of politicization of discourse specifically involves scientific literature. Articles challenging the claim of alarming response to anthropogenic greenhouse gases are met with unusually quick rebuttals. These rebuttals are usually published as independent papers rather than as correspondence concerning the original articles, the latter being the usual practice. When the usual practice is used, then the response of the original author(s) is published side by side with the critique. However, in the present situation, such responses are delayed by as much as a year. In my experience, criticisms do not reflect a good understanding of the original work. When the original authors' responses finally appear, they are accompanied by another rebuttal that generally ignores the responses but repeats the criticism. This is clearly not a process conducive to scientific progress, but it is not clear that progress is what is desired. Rather, the mere existence of criticism entitles the environmental press to refer to the original result as 'discredited,' while the long delay of the response by the original authors permits these responses to be totally ignored.

A final aspect of politicization is the explicit intimidation of scientists. Intimidation has mostly, but not exclusively, been used against those questioning alarmism. Victims of such intimidation generally remain silent. Congressional hearings have been used to pressure scientists who question the 'consensus'. Scientists who views question alarm are pitted against carefully selected opponents. The clear intent is to discredit the 'skeptical' scientist from whom a 'recantation' is sought.

The news media is frequently used as an instrument for this intimidation. A notable example in the early 1990's was Ted Koppel's Nightline program. He announced that Vice President Gore had asked him to find connections to unsavory interests of scientists questioning global warming alarm. Koppel, after editorializing on the inappropriateness of the request, proceeded to present a balanced exposure of the debate. Newspaper and magazine articles routinely proclaimed that scientists who differ with the consensus view are stooges of the fossil fuel industry. All of this would be bad enough, but the real source of intimidation was the fact that neither the American Meteorological Society nor the American Geophysical Society saw fit to object to any of this.

These are not isolated examples. Before 1991, some of Europe's most prominent climate experts were voicing significant doubts about climate alarm. Note that the issue has always concerned the basis for alarm rather than the question of whether there was warming (however small) or not. Only the most cynical propagandist could have anticipated that sentient human beings could be driven into panic by the mere existence of some warming. In any event, among these questioners were such distinguished individuals as Sir John Mason, former head of the UK Meteorological Office, and Secretary of the Royal Society, Prof. Hubert Lamb, Europe's foremost climatologist and founder of the Climate Research Unit at East Anglia University, Dr. Henk Tennekes, Director of Research at the Royal Dutch Meteorological Institute, and Professor Aksel Wiin-Nielsen of the University of Copenhagen and former Director of the European

Centre for Medium Range Weather Forecasting, and Secretary General of the World Meteorological Organization. All of these figures except Tennekes have disappeared from the public discourse. Lamb is now dead. Tennekes was dismissed from his position, and Wiin-Nielsen was tarred by Bert Bolin (the first head of the IPCC) as a tool of the coal industry. In Russia, a number of internationally recognized pioneers of climate science like K. Kondratyev and Y. Izrael, continue to vocally oppose climate alarm, but Russian scientists eager for connections with the rest of Europe are much more reluctant to express such views.

Not all such situations ended badly. When a senior Energy Department official, William Happer, was dismissed in 1993 after expressing questions about the scientific basis for global warming claims, the physics community was generally supportive and sympathetic[18]. In another more bizarre case, an attempt was made to remove the name of Roger Revelle from an already published paper he coauthored with S. Fred Singer and Chauncy Starr, by claiming that Singer had cajoled an allegedly senile Roger Revelle into permitting himself to be so used. This paper discouraged hasty action on ill-understood warming. It should be noted that Revelle was the professor who Al Gore frequently cites as having introduced him to the horrors of global warming. In any event, Singer took the issue to court and won. His description of the case makes interesting reading[19].

More recent is a controversy over a 1000 year reconstruction of mean temperature purporting to show that the half degree (Centigrade) rise of the past century was unprecedented[20]. Because of the extensive use of this work in the politics of global warming, Congressman Joe Barton demanded the analytical detail since the research was supported by US funds. Both the American Meteorological Society and the American Geophysical Union protested Barton's request. One need not go into the merits of this controversy to see that this difference in the response of professional organizations sends a rather chilling message. Only the defenders of the orthodoxy will be defended against intimidation.

I want to emphasize that the *basic agreement* frequently described as representing a global warming 'consensus' is entirely consistent with there being virtually no problem. Actual observations suggest that the sensitivity of the real climate is much less than found in computer models whose sensitivity depend on processes which are clearly misrepresented. Attempts to assess climate sensitivity by direct observation of cloud processes, and other means, point to a conclusion that doubling $CO_2$ would lead to about 0.5C warming or less.

Unfortunately, a significant part of the scientific community appears committed to the maintenance of the notion that alarm *may* be warranted. Alarm is felt to be essential to the maintenance of funding. The argument is no longer over whether the models are correct (they are not), but rather ***whether their results are at all possible***. Alas, it is impossible to prove something is impossible. The global warming issue parts company with normative science at an early stage. A good indicator of this disconnect is widespread and rigorous scientific agreement that the Kyoto Agreement would have no discernible impact on climate. This clearly is of no importance to the thousands of

negotiators, diplomats, regulators, general purpose bureaucrats and advocates whose livelihood is tied to climate alarmism.

A rarely asked but important question is whether promoting alarmism is good for science? The situation may not be so remote from the impact of Lysenkoism on Soviet genetics. However, personally, I think the future will view the response of contemporary society to 'global warming' as simply another example of the appropriateness of the fable of the *Emperor's New Clothes*. For the sake of the science, I hope that future arrives soon. In the mean time, we can continue to play our parts in this modern version of *The Emperor's New Clothes*. Our descendents will be amused for generations to come.

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**Endnotes**

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