

CLIMATE ALARM - Where Does it Come From?

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Houston Forum

September 9, 2004

(A copy of this lecture is available to anyone who either leaves me their email address or emails their request to lindzen@mit.edu.)

My personal experience over the last 16 years leads me to the conclusion that when it comes to politicized science, real communication is almost impossible.

First, it leads to a meaningless polarization associated with meaningless questions:

Do you believe in global warming?

Are you a skeptic or a believer?

Given the many facets of the issue, if you are a believer, what exactly is it that you believe?

Depending on whether you are a believer or not, you are likely to hear only what you expect to hear.

This leads to the obvious question:

What in the world am I doing here?

I'm not sure I can answer that except to say that hope springs eternal.

At least, to quote St. Thomas More, before his beheading, "I will be brief."

Let me begin by saying what I **won't** be talking about.

I am not going to speak about whether the global mean temperature is increasing or not. The question, as phrased, is only of importance because of politics and scientific illiteracy. After all, the global mean temperature is never constant and it has no choice but to increase or decrease – both of which it does on all known time scales. That this quantity has increased about 0.6C (or about 1F) over the past century is likely.

A relevant question that I will address is *whether this is anything to be concerned about.*

It doesn't even matter whether recent global mean temperatures are 'record breakers' or even whether current temperatures are 'unprecedented.' All that matters is that the change over the past century has been small.

The fact that such claims are misleading or even false simply provides a temptation to discuss them and implicitly to attach importance to them. Remember, we are talking about tenths of a degree and all of you know intuitively that that isn't very much.

It **does** pay to speak about the levels of atmospheric CO₂.

They are increasing.

To be sure, over long periods, climate can cause CO₂ changes, but the increases observed over the past century are likely due to man's activities. When and if the levels double, they will increase the radiative forcing of the planet by about 4 Wm⁻² or about 2%. This **will** prove relevant.

The scientific question of relevance is what do we expect such an increase to do? The answer, most assuredly, is not to be arrived at by a poll of scientists – especially of scientists who do not work on this question.

The issue of consensus is, in this respect, extremely malign – especially when the consensus is merely claimed though not established. However, the whole idea of consensus is problematic.

With respect to science, the assumption behind consensus is that science is a source of authority and that authority increases with the number of scientists. Of course, science is not primarily a source of authority. Rather, it is a particularly effective approach to inquiry and analysis. Skepticism is essential to science; consensus is foreign. When in 1988, Newsweek announced that all scientists agreed about global warming, this should have been a red flag of warning. Among other things, global warming is such a multifaceted issue, that agreement on all or many aspects would be unreasonable.

Even within politics, the use of consensus is suspect. As Margaret Thatcher noted in *The Downing Street Years*, “CONSENSUS is the process of abandoning all beliefs, principles, values and policies in search of something in which no one believes , but to which no one objects; the process of avoiding the very issues that have to be solved. merely because you cannot get agreement on the way ahead.”

With respect to science, consensus is often simply a sop to scientific illiteracy. After all, if what you are told is alleged to be supported by all scientists, then why do you have to bother to understand it. You can simply go back to treating it as a matter of religious belief, and you never have to defend this belief except to claim that you are supported by all scientists except for a handful of corrupted heretics.

Let us begin by considering the fundamental question of whether the observed increases in CO₂ are likely to be a source of alarm. We will see how the matter of consensus has been employed to mislead and misinform the public. It matters little that the claimed consensus is not based on any known polling of scientists.

IPCC 1995 SPM:

Intergovernmental Panel on Climate Change - a UN body to provide a consensus in support of negotiations

Summary for Policymakers - a front end to IPCC reports prepared largely by non scientists to 'summarize' and 'interpret' the IPCC reports.

The balance of evidence suggests a discernible human influence on global climate.

This was actually the 'smoking gun' for Kyoto.

Kyoto - an agreement negotiated in Kyoto wherein developed countries agree to limit greenhouse emissions to near 1990 levels by about 2010.

IPCC 2001 SPM draft:

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.

IPCC 2001 SPM:

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.

Note the differences from the draft.

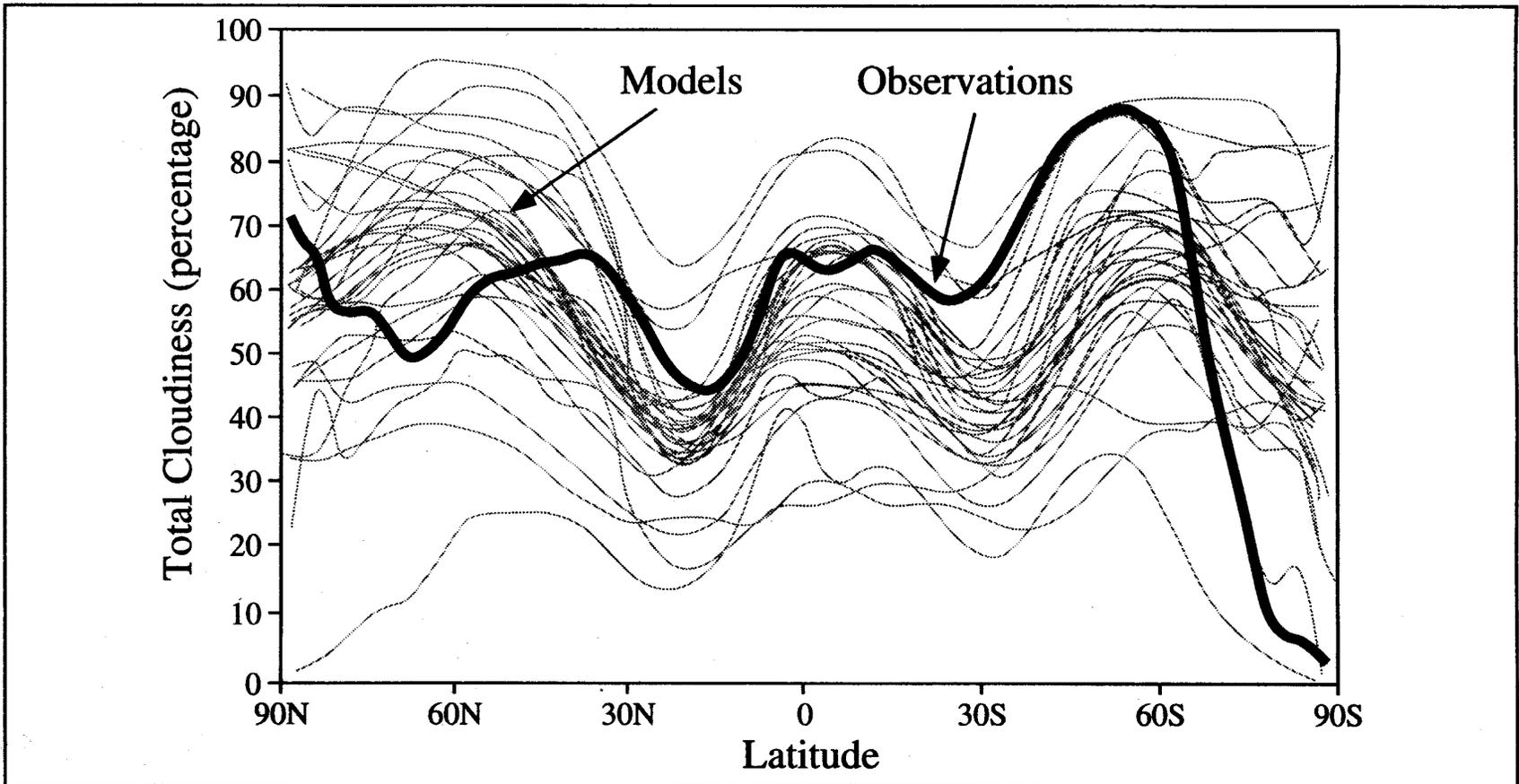
However, arguing over such matters tends to obscure the meaning and implications of what is being said. Consider the following:

- A doubling of CO₂ produces a climate forcing of a bit less than 4 Watts per square meter;
- Greenhouse gas increases have already produced forcing of about 2.8 Watts per square meter; and
- Models that predict large warming have a sensitivity of about 4C (or 7F) for forcing of 4 Watts per square meter.

The sensitivity to a doubling of CO₂ alone is only about 1C (or 1.8F); however, **in models**, the most important greenhouse substances, water vapor and upper level clouds, act to greatly amplify this response. Note that according to the IPCC, treatment of water vapor and clouds represent major model uncertainties.

Here we see that treatment of clouds involves errors an order of magnitude greater than the forcing from a doubling of CO₂

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.



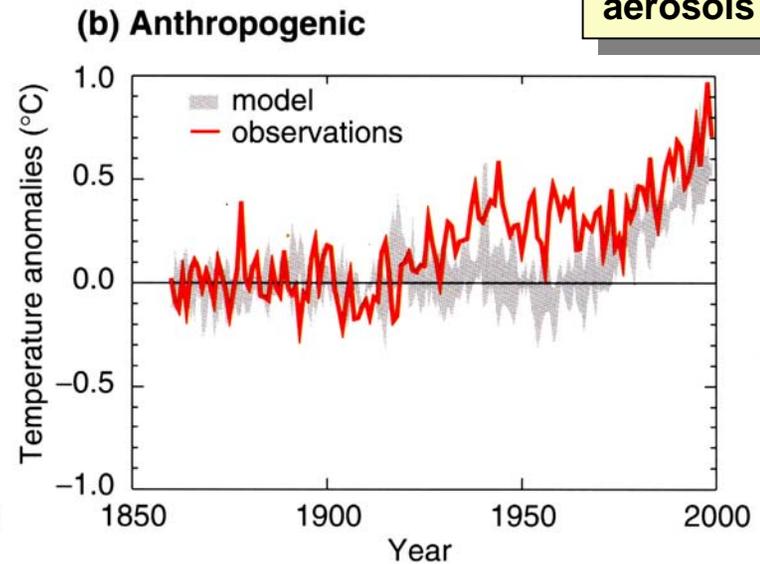
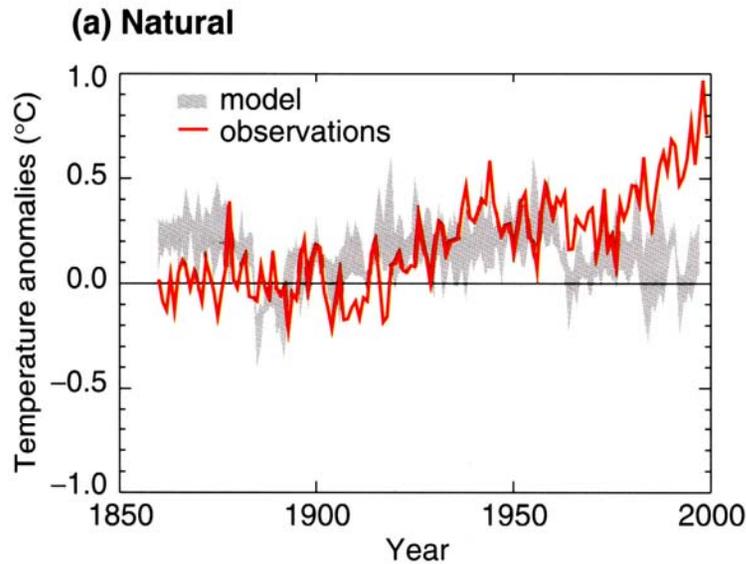
Regardless of obvious major model shortcomings, the following is a more accurate and relevant statement:

Our concerns over global warming are based on models rather than data, and if these models are correct, then man has accounted for over 4 times the observed warming over the past century (even allowing for ocean delay) with some unknown process(es) having cancelled the difference. We will assume moreover that these unknown processes will cease for future predictions.

This statement illustrates that the observations do not support the likelihood of dangerous warming, but our ignorance may be sufficient to allow the possibility. In point of fact, our ignorance is probably not that great.

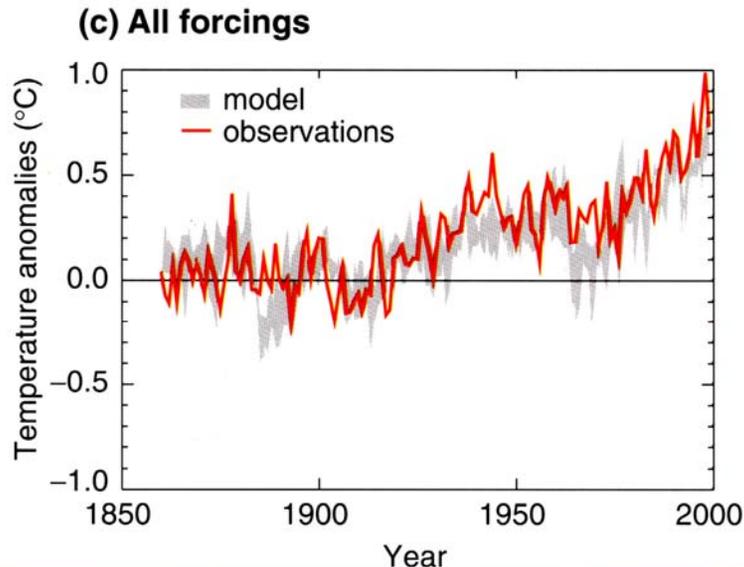
How do we reconcile this with the claim that present models do a good job of simulating the past century?

Simulated annual global mean surface temperatures



Note that anthropogenic includes unknown aerosols

Note that 'natural' includes Solar Forcing and Volcanoes which we really don't know. The spread in the grey curve represents internal variability at a level 2-3 times smaller than suggested by observations.

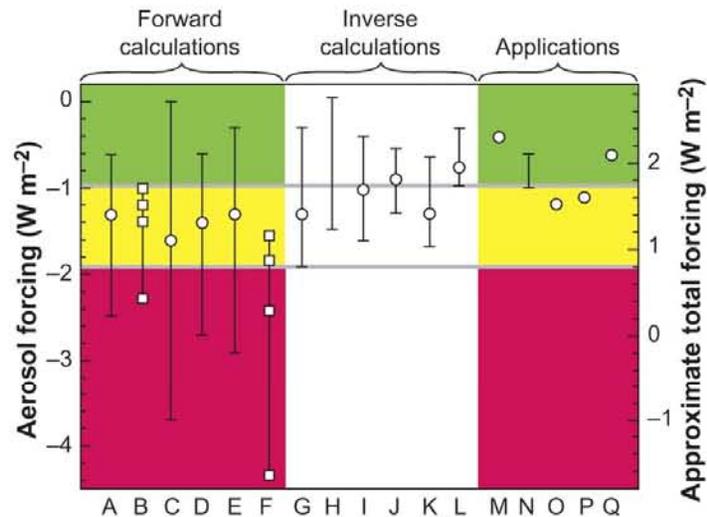


There is actually no indication of uncertainty.

Olivier Boucher, Henning Rodhe, Jost Heintzenberg

The global average surface temperature has risen by 0.6 K since the late 19th century. Ocean heat content has increased, and other climate indices also point to a warming world. Many studies have attributed this warming largely to top-of-atmosphere radiative forcing—a change in planetary heat balance between incoming solar radiation and outgoing infrared radiation—by anthropogenic greenhouse gases (GHGs) (1, 2).

Such attribution studies compare temperature observations to climate model simulations forced by various industrial-era agents. Among these agents, GHGs have well-constrained positive forcings (creating a warming influence) (3). In contrast, the mostly negative forcings (cooling) as-



Uncertainties in aerosol forcings. Global-mean anthropogenic aerosol forcing over the industrial era (left axis) as estimated by forward (A to F) and inverse (G to L) calculations and as used in applications (M to Q) (20). Circles with error bars are central values and 95% confidence limits. Bare error bars are stated range. Squares represent specific forcing calculations using alternative formulations within the same study. Right axis: Total forcing over the industrial era using the approximation that nonaerosol forcings are 2.7 W m^{-2} (3, 4).

calculations is considerably greater, centered around -1.5 W m^{-2} , with an uncertainty range that extends beyond -3 W m^{-2} . The larger magnitude aerosol forcings from the forward calculations greatly exceed the largest values allowed by the inverse calculations (see colored bands in the figure).

The substantial region of inconsistency shown in the figure (the red and, depending on the study, yellow bands) implies either that the large-magnitude aerosol forcings from the forward calculations are erroneously high or, alternatively, that the limits on aerosol-forcing magnitude inferred from the inverse calculations are erroneously low. We caution against simply assuming the former. The forward calculations are based on a substantial body of aerosol and cloud measurements, observation-based parameterizations of aerosol-cloud interactions, and well-understood physics of radiative transfer.

The inverse calculations are also based on sound physical principles. However, to the extent that climate models rely on the results of inverse calculations, the possibility of circular reasoning arises (5)—that is

The inverse calculations are also based on sound physical principles. However, to the extent that climate models rely on the results of inverse calculations, the possibility of circular reasoning arises (5)—that is, using the temperature record to derive a key input to climate models that are then tested against the temperature record. Rather than rely exclusively on one approach or the other, it is prudent to acknowledge the current inconsistency and seek to understand and resolve it.

Unfortunately, virtually all climate model studies that have included anthropogenic aerosol forcing as a driver of climate change (diagnosis, attribution, and projection studies; denoted “applications” in the figure) have used only aerosol forcing values that are consistent with the inverse approach. If such studies were conducted with the larger range of aerosol forcings determined from the forward calculations, the results would differ greatly.

In brief, we start by assuming the model is correct including its internal variability.

We then attribute differences between the model behavior in the absence of external forcing, and observed changes in ‘global mean temperature’ to external forcing.

We separately introduce ‘natural’ and ‘anthropogenic’ forcing in such a manner as to obtain a ‘best fit’ to observations.

If we succeed (which is inevitable in this procedure), we assert that the attribution of part of the observed change to the greenhouse component of the ‘anthropogenic’ forcing must be correct.

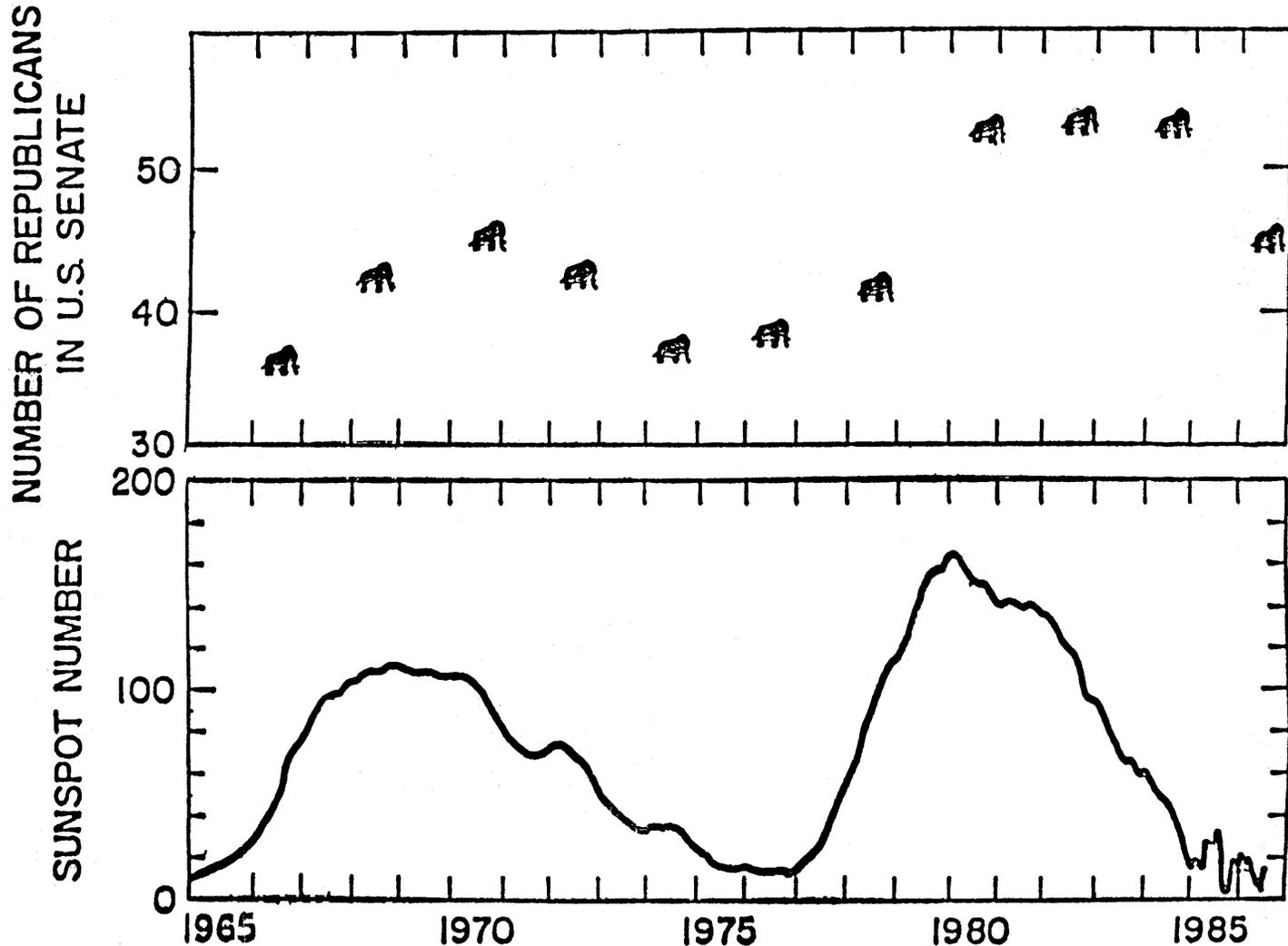
That said, the preceding charts were based on a model which had relatively low sensitivity (2.5C for a doubling of CO₂). This facilitated the process.

Of course, model internal variability is not correct, and ‘anthropogenic’ forcing includes not only CO₂ 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.

This would have been an embarrassment even to the Ptolemaic epicyclists yet an almost identical analysis has just been presented to our government.

The preceding analysis depended on the presence of many adjustable parameters. It is hardly better than the following attempt to relate Republicans in the Senate to sunspots.



My second example is one where consensus (as represented by all contemporary text books on atmospheric dynamics) exists, but does not support alarm. Consensus is therefore claimed for *exactly the opposite* of what science agrees on.

Here is the correct statement:

In a warmer world, extratropical storminess will be reduced as will variance of temperature.

Is this what you hear?

Sir John Houghton (the first editor of the IPCC scientific assessments) made the casual claim that a warmer world would have more evaporation and the latent heat would provide more energy for disturbances. This claim is based on a number of obvious mistakes (though the claim continues to be repeated by those who don't know better).

In point of fact, for Sir John's claim to even be partially true, the warmer world would have to be accompanied by lower relative humidity thus reducing the positive feedback that makes possible the prediction of warming in excess of about 1C for a doubling of CO₂.

Given the speciousness of the bases for alarm, it is perhaps unsurprising that there is real consensus on the following item, though the consensus is barely mentioned.

Kyoto, itself, will have no discernible impact on global warming regardless of what one believes about climate change.

Claims to the contrary generally assume that Kyoto is only the beginning of an ever more restrictive regime. However, this is hardly ever explained to the public.

The situation in the climate change issue is part of a long tradition.

George Orwell wrote that language “becomes ugly and inaccurate because our thoughts are foolish, but the slovenliness of our language makes it easier for us to have foolish thoughts.” There can be little doubt that the language used to convey alarm has been sloppy at best.

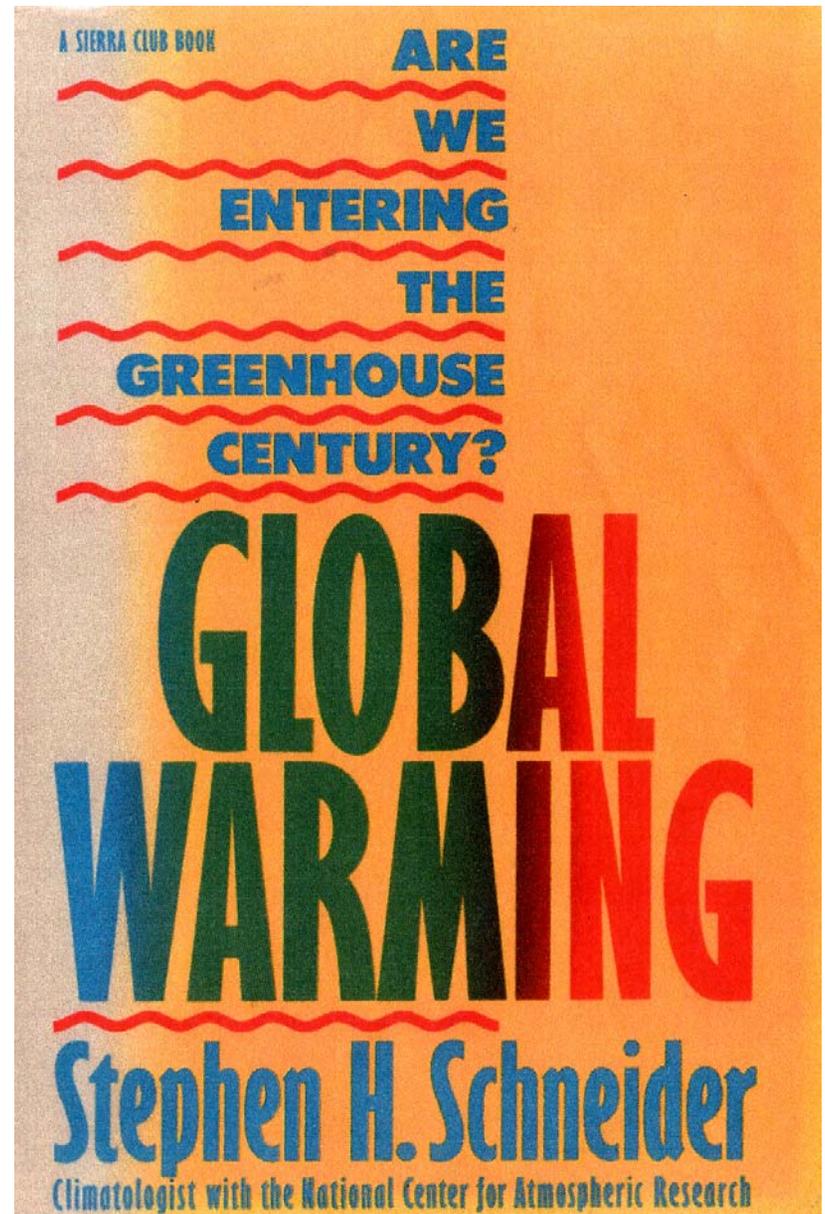
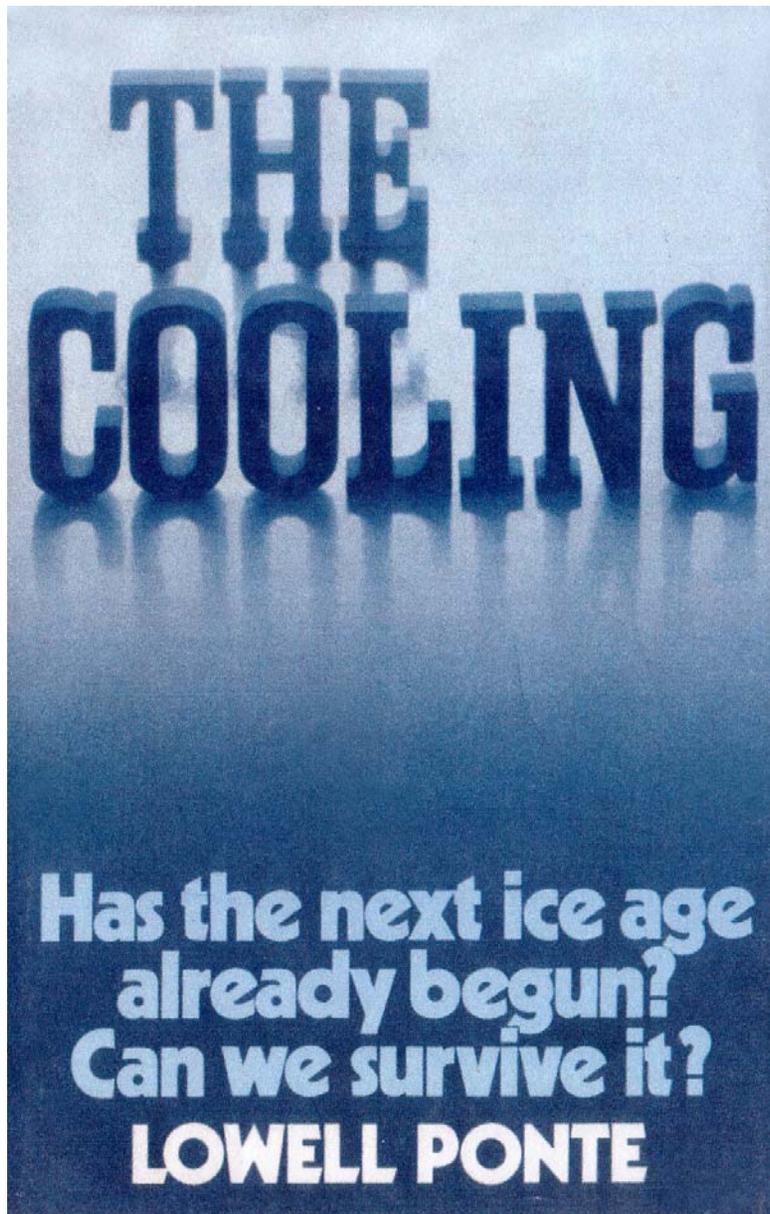
It was Josef Goebbels who said that if you repeat a lie often enough, people will believe it. Forgetting outright lies for the moment, there is little question that repetition makes people believe things for which there may be no basis.

So where does all this leave us?

1. The data currently represented as 'consensus,' even if correct, does not imply alarm. However, where the consensus view is too benign, the opposite of the real consensus is claimed to be the consensus. In much current research, 'alarm' is the aim rather than the result.

2. The scientific community is 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. One can rarely prove something to be impossible.

3. No regulatory solution to the 'problem' of preventing increases in CO₂ is available, but the ubiquity of CO₂ emissions which are associated with industry and life itself remains a tempting target for those with a regulatory instinct who have always been attracted to the energy sector.



(also author of preface to book on left) 29

4. Resistance to such temptations will require more courage and understanding than are currently found in major industrial or governmental players who largely accept what is presented as the consensus view. The main victims of any proactive policies are likely to be consumers, and they have little concentrated influence. As usual, they have long been coopted by organizations like Consumers Union that now actively support Kyoto.

If you find that what I have presented is disheartening and discouraging, I can only say that after 16 years with this issue, I agree. However, perhaps it is possible that you have learned something from this lecture, so here is a spot quiz.

Does the following preface to a famous report, commonly cited as demanding US adherence to Kyoto, contain anything that should be alarming?

CLIMATE CHANGE SCIENCE

AN ANALYSIS OF SOME KEY QUESTIONS

NRC 2001

Greenhouse gases are accumulating in Earth's atmosphere as a result of human activities, causing surface air temperatures and subsurface ocean temperatures to rise. Temperatures are, in fact, rising.

The changes observed over the last several decades are likely mostly due to human activities, but we cannot rule out that some significant part of these changes is also a reflection of natural variability.

If your answer is 'no,' and you can explain why, then perhaps there is some hope for a saner future.