Critique of the Inhofe 400 Report

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November, 2008

Executive Summary

The United States Environment and Public Works Committee published a minority report on December 20, 2007, titled "U. S. Senate Report Over 400 Prominent Scientists Disputed Man-Made Global Warming Claims in 2007 Scientists Debunk 'Consensus'", written by Marc Morano, a career journalist and Matthew Dempsey. Morano and Dempsey are Inhofe staffers (Inhofe, 2007).

This report is referred to herein as the "Inhofe-400" report. The report is written to counter the Anthropogenic Global Warming (AGW) Theory described in the Intergovernmental Panel on Climate Change (IPCC) report published in 2007 (IPCC, 2007).

These two reports are evaluated against three criteria and compared for scientific content and credibility: 1) author competence with respect to the subject matter: climate physics; 2) citation and attribution to appropriate refereed scientific journals and other sources, i. e., are statements verifiable; and 3) rigor of the peer-review process applied to each of these reports.

The Inhofe-400 report is a collection of opinions culled from blogs, op/ed pieces, newspaper articles and letters-to-the-editor, many from obscure sources, and none of which are verifiable, which criticize the IPCC report.

Author/Editor competence is important even when compiling an anthology of opinion on a scientific topic. One should be able to evaluate scientific literature with respect to its credibility, relevance and verifiability. Much of the coverage of scientific topics by reporters is inaccurate, based as it usually is on press releases, and is therefore "bad" science. However, so long as the article references the peer-reviewed journal article upon which the press release is based, it contains useful information as the reader can verify the content and may yet be "good" journalism. Without attribution, the story contains no credible information and is both "bad" science and "bad" journalism. Most reporters are in fact not competent scientists but many at least are competent journalists. Journalism that contains verifiable reference to the scientific literature can be useful even if the story is inaccurate.

The Inhofe-400 report could be completely wrong about the science of global warming and yet be worthwhile if it contained adequate attribution, which it does not. On the other hand, it could be in some sense correct but without adequate attribution, it cannot be useful because any useful information it may contain cannot be verified. Without attribution, the Inhofe-400 report is both bad science and bad journalism. That one of the authors, Marc Morano is rather inappropriately recognized as a "global warming expert" by the Heartland institute does not override the fact that he does not have even a minimal scientific education necessary to be considered an expert on any scientific topic, let alone one as complex as climate physics. Indeed, many of the denial arguments presented in Inhofe-400 arise not from the scientific literature but from a science fiction novel "State of Fear" by Michael Crichton, and two of the Inhofe-400 "prominent scientists" reference this fiction.

Five of the most popular AGW denier arguments cited in Inhofe-400 report are examined in this critique:

- *the troposphere argument,*
- *the solar argument,*
- *the hockey stick argument,*
- *the ice-age predicted in the seventies argument, and*
- *the economic argument.*

The first three are loosely based on science. The fourth is based on a rather nonsensical statement made by a fictional character in the novel "State of Fear". The fifth is not at all able science. At no point in the Inhofe-400 report are these five arguments appropriately attributed. All five are shown to contradict evident data and analysis. In addition, a few of the more specious arguments are also critiqued to make the point that Inhofe-400 contains many opinions that more knowledgeable authors would have left out. A few opinions are cited which actually undermine the apparent ideology of the Inhofe-400 authors.

The science historian Naomi Oreskis has made the case that Anthropogenic Global warming denial such as reflected by the Inhofe-400 report may represent ideological opposition to government regulation of large multinational corporations such as by the imposition of a carbon tax or a cap-and-trade policy to limit carbon emissions rather than a scientific hypothesis. This ideology curiously opposes subsidies for conservation and alternative energy presumably because small government should not regulate the private sector but supports subsidies for existing extractive industries. This ideology supports the elimination of all government regulations even those intended to protect human health and the environment. In fact, several of the "prominent scientists' such as S. Fred Singer, are also former tobacco lobbyists and others such as the oft cited blogger Jennifer Marohasy, work for lobby companies which are chartered to oppose government regulation of the large corporations which fund them. Oreskis' observation may explain why so many of the collected comments reflect flawed economics rather than bad science.

The economic opinions cited within Inhofe-400 are alarmist in nature, predicting all sorts of economic calamity if the policies opposed by the authors were to be enacted. Interestingly all the predictions eventually did come true and in fact were, with hindsight, evidently well underway as the Inhofe-400 report was being published even though the Bush administration faithfully adhered to precisely the ideology recommended by the commenters and despite the rather ironic fact that none of the policies we were being warned about were ever implemented. Coincidentally, the current economic meltdown rivals the Great Depression, caused, apparently, by the same business-friendly policies of deregulation and tax cuts for the already wealthy that characterized the Harding/Coolidge/Hoover administrations. Then treasury secretary Andrew Mellon famously remarked that "the welfare of the middle class and poor depend on the light taxation of the rich." This ideology makes as much sense today as it did then. While outside the scope of this critique, what this ideology fails to comprehend is, as Vaclav Smil observes, energy is the currency of society and nature, not capital formation. Indeed, Herman Daly, former chief economist of the World Bank, successfully predicted the current economic collapse by observing that accumulated capital was growing much faster than resources, being energy and material. One might observe that we do not have a crisis of capital availability but a crisis of reality comprehension.

By contrast, the IPCC report is driven by science which spans multiple disciplines and accurately reflects the work encapsulated in thousands of up-to-date peer-reviewed journal articles. It was written by many scientists who really are recognized global warming experts. While it is reasonable and even appropriate to be skeptical of any scientific document including the IPCC report, it is impossible to be knowledgeably skeptical of this report yet accept unquestioningly the unsupported opinions expressed in the Inhofe-400 report.

A summary comparison of the two reports is given in Table 1.

Table 1 Comparison of IPCC AR-4 with Inhofe-400

criteria	IPCC AR4	Inhofe - 400
authors	1200 scientists and other professionals	2 journalists
reviewers	Approximately 1000 scientists and other expert professionals	None
Scientific references	6400	14
inclusivity	Reviewers and authors included contrarian, consensus and concerned viewpoints	Includes contrarians exclusively

Disclaimer

The study of a planet's climate involves the mastery of very difficult physics and mathematics. Fundamentally, a planet's climate is determined by the strength of the insolation from its sun, its orbit and its atmospheric composition. Orbital variation modulates insolation. Plate tectonics, volcanism, and rock weathering and, in the case of a planet with life, biological processes continuously modify the composition of the planet's atmosphere. The interplay of these interconnected processes determine that Venus has a surface temperature of 462^{o}C (863^{o}F) and Mars has a surface temperature which varies between -87^{o}C (-125^{o}F) and -5^{o}C (23^{o}F) the Earth alone of our sun's planets has a surface temperature suitable to support liquid water and thus the evolution of complex eukaryotic life currently 15^{o}C (59^{o}F).

Because of the importance of Anthropogenic Global Warming (AGW), many non-specialist scientists and engineers, like me, with a reasonably good background in a related field and with some curiosity and time on our hands, have studied the topic to some depth. But we are not global warming experts.

As a non expert, I am not attempting to weigh in on the science of AGW nor the hypothesis which describe the current warming, being a difficult task beyond my expertise. What I can do, is judge the scientific credibility and content of documents which claim to weigh in on the controversy against the easily understood and measureable properties described above. It is rather straightforward to examine an opinion against its attribution to data and analysis. If there are no references, the reader is on his/her own to discover scientific literature which weighs in on the opinion. If the accumulated science contradicts the opinions then the opinion, itself, contains no scientific information and should be skeptically rejected.

Introduction

The Intergovernmental Panel on Climate Change (IPCC) was formed in 1988 by the United Nations Environmental Programme (UNEP) and the World Meteorological Organization (WMO). This panel was tasked to evaluate the impact of human activity on climate. Of particular concern is the rapid, on a geological scale, emissions of carbon dioxide (by the combustion of fossil fuels) and other greenhouse gases which is proceeding at a rate 100 times faster than would occur naturally via volcanism, digenesis and metamorphism (Berner, 2003).

During its life, the IPCC has issued four Assessment Reports (AR) in the years 1990, 1995, 2001 and 2007 and a Supplement to AR-1 in 1992.

The IPCC report authors are all scientists and other experts, such as ecological economists, who analyze the available scientific literature and evaluate it in order to estimate the impact of human activity and natural phenomena on the near term future Earth climate. The latest AR-4 report, published in 2007, has 1200 listed qualified authors and contributors and there were about the same amount of expert reviewers. Approximately 6400 scientific journal articles were reviewed. Its conclusions form the consensus opinion. This consensus is shared by the vast majority of scientists as evident from the numbers of world wide scientific organizations which have endorsed this theory including:

- National Oceanic and Atmospheric Administration
- Environmental Protection Agency
- NASA's Goddard Institute of Space Studies
- American Geophysical Union
- American Institute of Physics
- National Center for Atmospheric Research
- American Meteorological Society
- State of the Canadian Cryosphere
- The Royal Society of the UK
- Canadian Meteorological and Oceanographic Society

Criticism of the IPCC report

In order to avoid inflammatory labels such as “deniers” and alarmists” those critics of the consensus view who think the report is too pessimistic, i.e., those who do not consider carbon dioxide to be a strong greenhouse gas or who believe that natural causes dominate Earth’s recent climate change, are called “contrarians” and those critics who think the report is too optimistic or ignores strong positive feedbacks in the Earth climate system, are called “concerned”. “Skeptic” is inappropriate because hopefully all good scientists are skeptical but it is not enough to be skeptical of the majority opinion on any scientific topic. A real skeptic is equally skeptical of minority views as well.

However, there are certainly opinions expressed with respect to the consensus or concerned views which are alarmist. For example, while it is possible that there is a level of atmospheric CO2 which commits the Earth to a sea level rise of six meters or more at some time in the future, the probability of that level of rise occurring during the next hundred years is remote and opinion that this will happen may be alarmist. There is an argument on the contrarian side which states that there was a consensus opinion in the 70’s that the Earth climate was about to slip into another ice

age and now climate scientists are warning us that the Earth is about to slip into a hot house climate. For some reason, if they were wrong then, they must also be wrong now. Besides being illogical it is also incorrect. There was no consensus opinion during the seventies among climate scientists. The origin of this myth is the utterance of a fictional character in Michael Crichton's book "State of Fear". This opinion is not scientifically skeptical, but is evidence of denial.

Figure 1 (Roe, 2007) which shows the probability density distribution of the Equilibrium Climate Sensitivity (ECS) can be used to illustrate the difference between the three points of view. ECS is the amount the Earth's climate is expected to warm if the atmospheric carbon dioxide were to be doubled and after the solar energy entering the Earth system reaches equilibrium with the long wave energy escaping into outer space. Since the temperature of the Earth surface is approximately a logarithmic function of the volume of CO2, it is insensitive to temporal scaling, i.e., the surface would warm by 3°C whether the concentration were to be doubled from 100 ppmV (parts per million by Volume) to 200 ppmV or from 1000 ppmV to 2000 ppmV. The consensus view is that ECS

> "is estimated, by the IPCC Fourth Assessment Report as likely to be in the range 2 to 4.5°C with a best estimate of about 3°C, and is very unlikely to be less than 1.5°C. Values substantially higher than 4.5°C cannot be excluded, but agreement of models with observations is not as good for those values."

The contrarian view is that ECS is approximately 0°C, or at least considerably less than about 1.5°C. The concerned view is that ECS may be higher than 4.5°C. James Hansen, director of NASA Godard Institute for Space Studies (GISS) and other scientists believe the ECS may be as high as 6°C, when slower surface albedo feedbacks and carbon cycle feedbacks are included, for the range of climate states between glacial conditions and an ice free Antarctica, based on the paleoclimate reconstruction of the Cenozoic (Hansen, 2008). The conclusion of the Roe, 2007 paper confirms the IPCC, 2007 report conclusion that values less than about 1.5°C can be ruled out but that values higher than 4.5°C may have diminishing probability but cannot be ruled out.

If atmospheric carbon dioxide were doubled and all other factors held constant such as cloud cover, water vapor, sea ice, etc. then ECS is about 1°C. This value is based on easily derivable physics and is unimpeachable (Rahmstorf, 2008). Therefore, the actual value of ECS is dependent on the sum of positive amplifying feedbacks and negative attenuating feedbacks. And therein lies the rub. An excellent description of this feedback process is given by Peixoto (1992). While a discussion of all these feedback mechanisms are out of scope for this document, a simple example is given.

As the level of CO2 increases in the atmosphere, the Earth's temperature increases. As a result, more water evaporates off the oceans. Since water vapor is itself a greenhouse gas, the Earth heats up further. The climate cannot run away as eventually, the Earth heats up enough so that outgoing infrared energy again reaches equilibrium with incoming short wave solar radiation. As an aside, while water vapor is a very strong amplifying feedback mechanism, it cannot be a forcing function. Physically, this is because the nominal temperature of the Earth is well below the condensation point of water. Observationally, at least three times during the Proterozoic, the temperature of the Earth dropped below freezing such that there is evidence of glaciations at low altitudes even at the equator. There was always the same amount of ocean surface and therefore availability of water vapor, yet the presence of evaporating surfaces did not keep the Earth warm. So other phenomena, believed to be a reduction of atmospheric carbon dioxide and methane, forced the climate to get colder. In fact, the fate of our planet would have been to remain frozen

forever, except for the emissions of CO2 from volcanoes and the resultant accumulation of the gas in the atmosphere.

Generally, the climate debate is about ECS feedbacks and just how much fossil fuel resources actually exist and are recoverable.

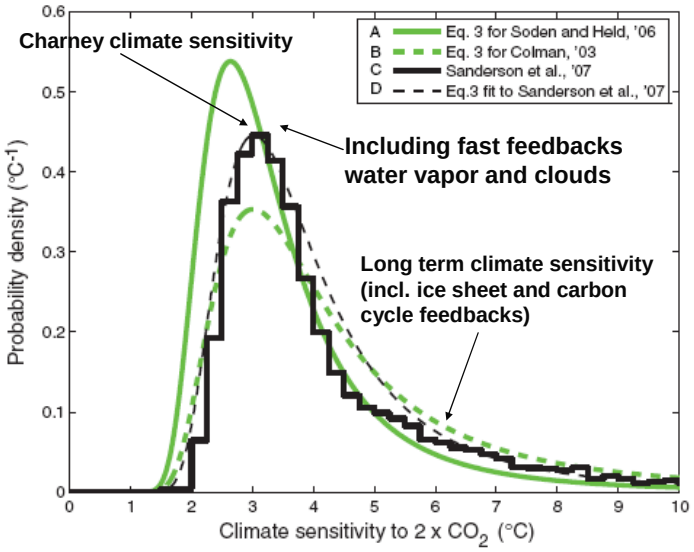

Figure 1 probability density distribution of equilibrium climate sensitivity from Roe, 2007

A description of some of the criticisms of the IPCC report can be found at the Wikipedia entry for the IPCC here. All views criticize the process to some extent and complain that it is to at least some degree political. From Wikipedia:

> "Political influence on the IPCC has been documented by the release of a memo by ExxonMobil to the Bush administration, and its effects on the IPCC's leadership. The memo led to strong Bush administration lobbying, evidently at the behest of ExxonMobil, to oust Robert Watson, a climate scientist, from the IPCC chairmanship, and to have him replaced by Pachauri, who was seen at the time as more mild-mannered and industry-friendly." (Pearce, 2002 and Borger, 2002)

Rajendra Pachauri, though hand picked by the Bush Administration, turned out to be quite free of political influence.

The contrarian views, critical of the IPCC report, often appear to be economic rather than technical. These arguments, though having nothing to do with climate science or anthropogenic global warming, are discussed below. The concerned views, critical of the IPCC report, include:

- Arctic sea ice melt was underestimated
- Sea level rise was underestimated (Rohling, 2007, Rignot, 2008, Pfeffer, 2008, Chen, 2006)
- Ocean and land absorption of human emissions of CO2 was overestimated (LeQuere, 2007, Raupach, 2007, Canadell, 2007, Jones, 2006, Friedlingstein, 2006, Schuster, 2007)
- Ocean acidification (Wootton, 2008)

- Melting permafrost as a positive feedback mechanism was not included (Zimov, 2006, Delisle, 2007, Lawrence, 2008)
- Deforestation from bark beetle and other insects was not accounted for (McKenzie, 2008)
- Other positive feedbacks may be underestimated (Scheffen, 2006)

Figure 2 illustrates that measured phenomena, such as Arctic sea ice extent and sea level rise, are exceeding the worst case projections of the IPCC AR-4 report. This is solid observational evidence supporting the concerned view. A thorough discussion on reasons why the IPCC report may underestimate global warming can be found in Pittock (2006).

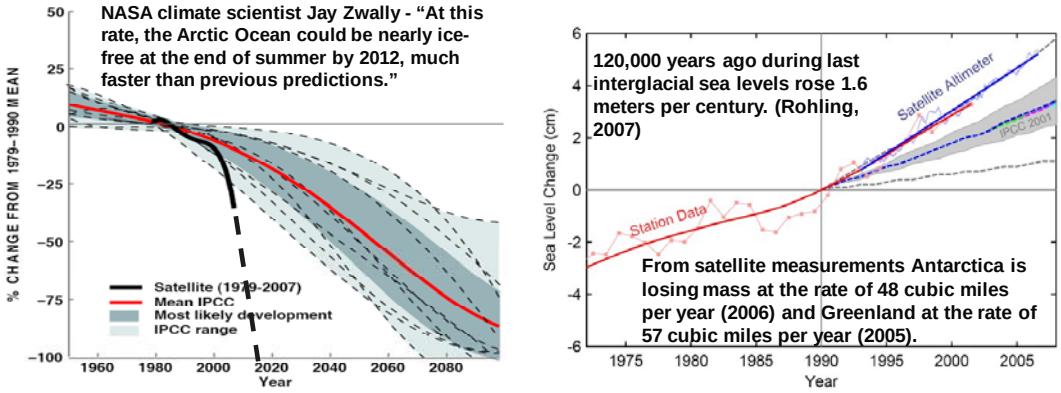

Figure 2 a) Arctic sea ice melting is exceeding worst case IPCC estimates and b) measured sea level rise is exceeding worst case IPCC report estimates.

An important contrarian view, reflected in the Inhofe-400 report is the view held by the peak oil (and coal and natural gas) community.

> Nathan Paldor, is quoted on page 10: "the inventory of fossil fuels is fairly limited and in one generation we will run out of oil. Coal and natural gas might take 100-200 years but with no oil their consumption will increase so they probably won't last as long." (Inhofe, 2007)
>
> Kjell Aleklett is quoted on page 79, "the combined volumes of these fuels are insufficient to cause the changes in climate….The world's greatest future problem is that too many people must share too little energy." (Inhofe, 2007)

However, these opinions do not support the main thesis of the Inhofe-400 report. Neither scientist necessarily dismisses the greenhouse effect of atmospheric carbon. Instead, they believe we may have a far more serious problem. Not only do we not have enough carbon fuel resources to cause serious AGW, we don't have enough fossil fuel energy sources to maintain our civilization at the current level for much longer. This is not necessarily a more pleasant outcome.

One of the more pessimistic estimates for remaining carbon contained in available coal, natural gas and petroleum may be 560 Gigatons Carbon (GtC) (Rutledge, 2007). I do not know if Paldor and Akelett are as pessimistic as Rutledge. Humans are consuming carbon based fuels at the rate of 8.5 GtC per year but we've used the most economically accessible resources. Remaining resources require more energy inputs for the same energy output. For example, the United States coal production as measured in tons has continued to increase but as measured by British Thermal Unit (BTU), or energy content, has actually peaked in 1998. (Lehmann, 2007). This is because

the quality of remaining coal reserves is diminishing. Most of the high quality Anthracite has been mined and the remaining resources include sub-bituminous coal and lignite. A ton of Anthracite can contain up to four times the energy content per ton of lignite coal.

An important observation is that either destiny: running out of fossil fuels before seriously harming the environment; or, having enough fossil fuels to seriously harm our environment, are fairly equally bad. Both can be avoided using the same strategies: conservation, and switching to alternative energy sources. On this point, Dave Rutledge, in a private correspondence, has written: "The only conclusion I am willing to draw is that it is the total remaining production that matters, rather than the rate. I am not competent to judge how dangerous the total remaining production is. My own preference is to fill the Mojave with solar concentrating plants, and save some of this wonderful stuff for our descendants."

Are Paldor and Aleklett correct to assume we do not have enough fossil fuel resources to cause serious global warming? Probably, they are not. The mass of the Earth's atmosphere is 5.15 10^6 Gt. Of this 0.0387% by volume is CO2 equivalent to about 810 GtC (see text box). We can derive ppmV CO2 by dividing GtC by 2.1. Using Rutledge's estimate, there is enough fossil carbon to increase atmospheric CO2 by 268 ppmV. Working in our favor, however, is the fact that land and ocean sinks currently absorb about 50% of our emissions, though there is evidence that these sources are becoming saturated (Canadell, 2007). Thus 560 GtC may increase atmospheric carbon by as much as 134 ppmV depending on how quickly it is extracted and consumed (divide 560 GtC by 2.1 to convert to ppmV and then by 2 since 50% is absorbed by the oceans and land sinks). However, the carbon stock in the Earth's forests is 288 GtC (Moutinho, 2005). This can increase atmospheric carbon by another 69 ppmV. Imagine a world inhabited by up to 9 billion humans who have no fossil fuels left to keep themselves warm. It is not hard to imagine all forests disappearing as this level of devastation has been caused by human societies locally in the past, e.g. Easter Island and Yucatan (Diamond, 2005).

To convert part per million by volume of CO2 into atmospheric Gigatons Carbon we need to compute the average molecular weight of the molecules in the atmosphere. The components are 78.08% Nitrogen with a molecular mass of 28, 20.9% Oxygen with a molecular mass of 32 and 0.9% Argon with a molecular mass of 40. Thus .7808 X 28 + .209 X 32 + 0.009 X 40 = 28.9. Carbon Dioxide has a molecular weight of 44 but the Carbon content of a CO2 molecule has a mass of 12. Thus multiply ppmV by 5.15 X 12/28.9 = 2.1 to compute GtC.

Thus even pessimistic levels of fossil fuels can raise atmospheric carbon dioxide above 550 ppmV without including any carbon cycle feedbacks such as possible carbon releases from thawing permafrost, perhaps a 1000 GtC, and methane hydrate deposits; and cement manufacture which is currently about .5 GtC per year. According to the IPCC report, this would be more than enough to substantially alter the Earth's climate.

Inhofe 400 analysis

The Inhofe-400 report was authored or compiled by Marc Morano and Matthew Dempsey who work for Senator Inhofe on the U. S. Senate Environment and Public Works Committee. Marc Morano is communications director for the Republicans on this committee. Morano began work with the committee under Senator James Inhofe, who was majority chairman of the committee until January 2007 and is now minority ranking member. Morano apparently has no scientific

background or credentials. Dempsey appears to be a public relations person and not a scientist and does not appear to have any scientific credentials either.

A thorough review of the Inhofe-400 report references shows that most are letters to the editor, op/ed pieces, articles and blogs. Only 14 peer-reviewed papers are either directly or indirectly cited, five of which contradict the contrarian view and are cited in an attempt to discredit them. A discussion of the temperature increase in the Earth's troposphere in the next section illustrates the unreliability of unattributed opinion.

Meteorologist George Waldenberger is on the list of "prominent" scientists who deny AGW theory. When informed he had made this list, Waldenberger sent the following email to Inhofe's staffers.

> "Take me off your list of 400 (Prominent) Scientists that dispute Man-Made Global warming claims. I've never made any claims that debunk the 'Consensus'. You quoted a newspaper article that's main focus was scoring the accuracy of local weathermen. Hardly Scientific … yet I'm guessing some of your other sources pale in comparison in terms of credibility.
>
> "You also didn't ask for my permission to use these statements. That's not a very respectable way of doing 'research'".

Waldenberger wrote this email on January 8, 2008 yet is still on the list. We can conclude that there was never any substantive review of the Inhofe-400 report.

Table 1 Comparison of IPCC AR-4 with Inhofe-400

criteria	IPCC AR4	Inhofe - 400
authors	1200 scientists and other professionals	2 journalists
reviewers	Approximately 1000 scientists and other expert professionals	None
Scientific references	6400	14
inclusivity	Reviewers and authors included contrarian, consensus and concerned viewpoints	Includes contrarians exclusively

The IPCC AR-4 report is a well-referenced, peer-reviewed credible scientific document. By comparison, the Inhofe-400 report is not credible and contains little or no actual science. While there may be a body of scientific work which supports the contrarian view and satisfactorily refutes the consensus view, the Inhofe-400 report is not that. At best, the Inhofe-400 report is a collection of unsubstantiated opinion. In the next few sections, a sampling of these opinions is examined.

Troposphere argument

Roy Spenser and John Christy wrote a paper in 1990 (Spenser, 1990) which attempted to reconcile weather balloon measurements of atmospheric temperature with satellite-based measurements. Satellite measurements began in 1978 but weather balloon data had existed for

decades. In their paper, which we will hereafter refer to as SC1990, the authors postulate that though the troposphere (the lowest layer of the atmosphere) had warmed, it had not warmed as fast as the surface temperature. Their results showed a warming trend of 0.09°C per decade, below the surface temperature trend of 0.17°C per decade.

There has never been a scientific paper written that suggested that the troposphere had not warmed at all. The importance of the paper to contrarian arguments was that climate models predict that the troposphere would warm faster than the Earth's surface when either CO2 was increased or solar luminosity increased. In other words, if the results from SC1990 held, then either the models were wrong or the cause of the observed Earth's surface temperature increase was neither solar nor AGW.

Thus the most popular contrarian argument became that SC1990 was proof that the climate models were not accurate. This was the central argument made in the original Oregon Petition written by astrophysicists (and Inhofe-400 "prominent scientists") Willie Soon and Sally Baliunas. The argument has since been dropped from the current version of the Oregon Petition when errors, described below, were later found in SC1990. Baliunas is no longer listed as an author of this revision though Soon still is.

The Inhofe-400 report contains these statements from contrarians

> Ben Herman wrote in a blog (Inhofe, 2007, page 13) "Now, the models also predict that the mid tropospheric warming should exceed that observed at the ground, but satellite data contradicts this."
>
> David Wojick wrote in a blog (Inhofe, 2007, page 8), "In point of fact, the hypothesis that solar variability and not human activity is warming the oceans goes a long way to explain the puzzling idea that the Earth's surface may be warming while the atmosphere is not. The GHG (greenhouse gas) hypothesis does not do this."
>
> Bob Carter wrote in an op/ed piece (Inhofe, 2007, page 64) "Lower atmosphere satellite-based temperature measurements, if corrected for non-greenhouse influences such as El Niño events and large volcanic eruptions, show little if any global warming since 1979, a period over which atmospheric CO2 has increased by 55 ppm (17 per cent)."

None of these citations are from the peer-reviewed literature. Had they been submitted to a refereed journal, reviewers would have insisted on references. Most reviewers would have, in fact, insisted on a reference to SC1990. Without a reference the statements cannot be validated and therefore contain no credible scientific information. By including this reference, Wojick would have been forced to change his text from "while the atmosphere is not" to something like "while the atmosphere is not warming quite as fast" and Carter would have been required to modify his statement from "show little if any" to "less warming than the surface."

Competent reviewers would have further insisted that all three discuss the controversy surrounding SC1990 and the latest developments.

In November 2005, Carl Mears and Frank Wentz (Mears, 2005) at Remote Sensing Systems (RSS) performed an independent analysis of the satellite data. In the process, they found an algebraic error in the SC1990 analysis which Christy and Spencer later acknowledged which

adjusted their estimate of the atmospheric warming upwards to 0.12°C per decade. Furthermore, Mears and Wentz performed their own data analysis and showed a trend of 0.19°C per decade, in line with the climate model predictions.

Since this was such an important foundation stone in the contrarian argument, the issue was adjudicated by the U. S. Climate Change Science Program in a paper (Wigley, 2006) co-authored by John Christy, which concludes:

> "Previously reported discrepancies between the amount of warming near the surface and higher in the atmosphere have been used to challenge the reliability of climate models and the reality of human induced global warming. *This significant discrepancy no longer exists* because errors in the satellite and radiosonde data have been identified and corrected. While these data are consistent with the results from climate models at the global scale, discrepancies in the tropics remain to be resolved.
>
> "This difference between models and observations may arise from errors that are common to all models, *from errors in the observational data sets*, or from a combination of these factors. *The second explanation is favored*, but the issue is still open." (Wigley, 2006)

Note that the reported discrepancy no longer exists and the most likely explanation for differences between climate models and observations may in fact be errors in the observational data sets.

The discussion continues to become ever more nuanced as the contrarian argument shifts from amount of warming to rate of change of the amount of warming in the tropical atmosphere (Douglass, 2007) on the contrarian side and (Santer, 2008) on the consensus side.

Interestingly, this is not the only time that climate models have proved more reliable than observational data sets. The early Cenozoic, for example, was characterized by a hot house climate. Models predict that both high latitudes and the tropics were significantly hotter than today because of the high levels of carbon dioxide in the atmosphere. However, while data confirmed the extremely high temperatures in the Polar Regions, data also suggested that the tropics may have been slightly cooler than today. This apparent paradox was eventually solved in favor of the climate models when diagenesis, the alteration of sediments after deposition, was taken into account (Kump, 2001 and Pearson, 2001). The corrected data now shows that tropical sea surface temperatures, 28^{o}C to 32^{o}C, were much higher than today, 25^{o}C to 27^{o}C, and were perhaps high enough to stress corals and other temperature-sensitive organisms. In fact, further support for the models is that corals were displaced to higher latitudes during warm intervals.

This discussion about the tropospheric temperature discrepancy confirms three points. The first is the obvious one that this particular contrarian argument has been put to rest and is no longer valid. The second is the additional evidence that climate models are indeed reliable. A more important third point is that opinions, even those of accomplished scientists which are expressed in blogs, letters-to-the-editor, op/ed pieces, or other non-peer-reviewed sources and especially those which are not verifiable by references to appropriate sources, such as those of Carter, Wojick and Herman, in fact contain no credible scientific information.

As mentioned, the troposphere argument was always inconsistent with the solar argument because whether the surface temperature is increasing because of increased solar activity or because of increased greenhouse gases then troposphere would warm faster than the Earth's

surface. So if in fact the troposphere was not warming as fast as the surface, then both a solar forcing and AGW would be ruled out as causes. See the next section.

Solar argument

Another pivotal contrarian argument, the most often proffered, is that the recent warming of the Earth's surface is due to an increase in solar irradiance.

A study by Usoskin et al. (Usoskin, 2005) has been frequently cited by contrarians because it concludes that the sun has been more active in the last 60 years than anytime in the past 1150 years and that temperatures closely correlate to solar activity. But the study also finds that the correlation between solar activity and temperature ended around 1975. At that point, temperatures rose while solar activity stayed level. This led them to conclude

> "during these last 30 years the solar total irradiance, solar UV irradiance and cosmic ray flux has not shown any significant secular trend, so that at least this most recent warming episode must have another source." And
>
> "The last 30 years are not considered, however. In this time the climate and solar data diverge strongly from each other."

Ironically, the evidence that establishes the sun's close correlation with the Earth's temperature in the past also establishes it's blamelessness for global warming today.

Figure 3, from the Max Planck Institute shows that solar irradiance has been steady since 1950 while the surface temperature anomaly has risen steeply since 1975.

This is confirmed by direct satellite measurements that find no rising trend since 1978, sunspot numbers which have leveled out since 1950, the Max Planck Institute reconstruction that shows irradience has been steady since 1950 and solar radio flux or flare activity which shows no rising trend over the past 30 years.

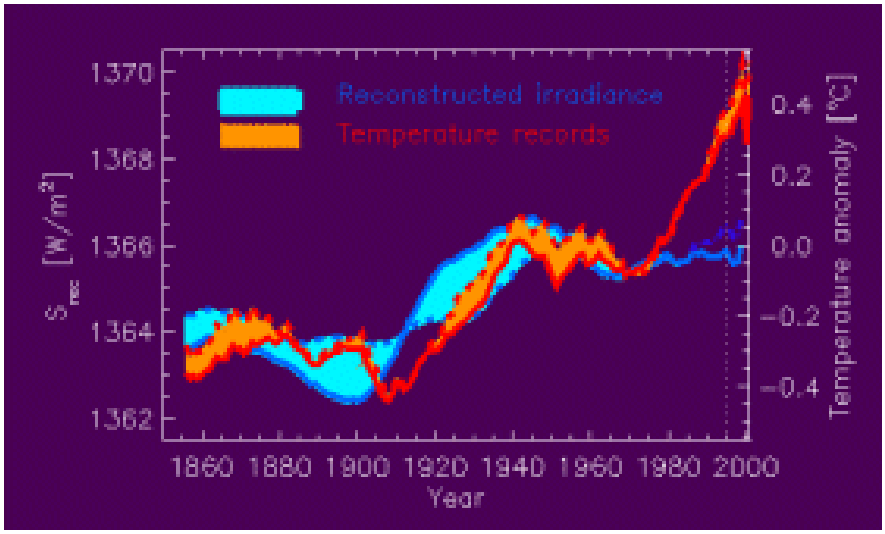

Figure 3, solar irradiance plotted with temperature records (Max Planck Institute)

Note that the difference in solar irradiance between the Maunder Minimum (the depth of the Little Ice Age) and today is 2 Watts per meter squared (W/m^2). This is the measured flux passing through a plane located at the Earth's outer atmosphere. Since the Earth is spherical, to calculate the average flux over the surface of the Earth's atmosphere, we need to divide by 4, thus the difference in insolation is 0.5 W/m^2. Moreover, 30% of this short wave radiation is reflected by clouds or the Earth surface without interacting at all. Thus Little Ice Age is attributed to a mere .3 W/m^2 forcing. The relatively small change in solar forcing must have been amplified by an as yet unidentified mechanism. This is rather alarming because the current forcing attributed to the current rise in atmospheric CO2 is 1.7 W/m^2, already, without accounting for amplifying feedbacks.

Furthermore, since 1950 there is no trend at all in Galactic Cosmic Rays (GCR) which might explain the recent warming as shown in Figure 4.

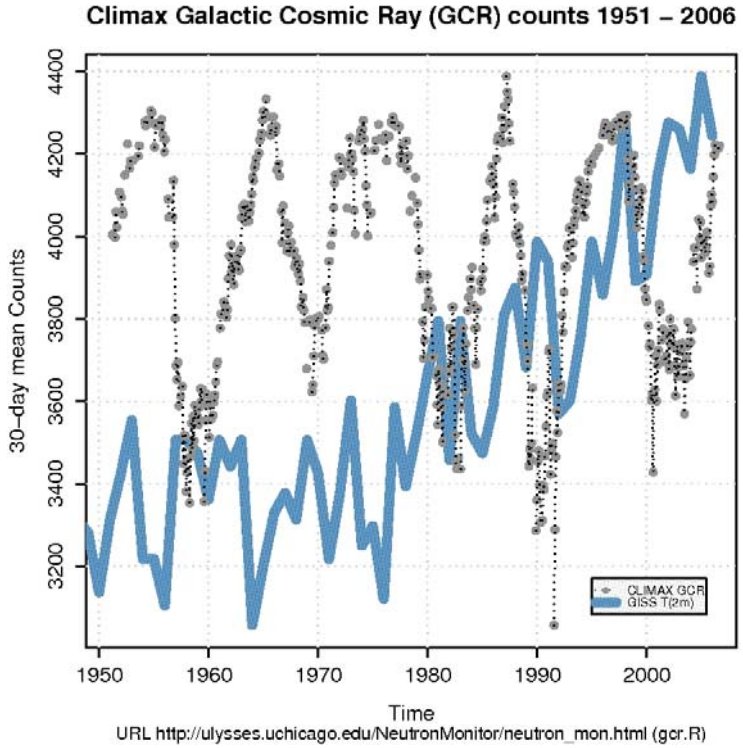

Figure 4, Climax Galactic Cosmic Ray counts from 1950 plotted with GISS temperature data.

There are many interesting palaeoclimate studies that suggest that solar variability had an influence on pre-industrial climate. There are also some detection–attribution studies using global climate models that suggest there was a detectable influence of solar variability in the first half of the twentieth century and that the solar radiative forcing variations were amplified by some mechanism. However, there would appear to be no solar influence on the climate warming over the last three decades.

The contrarian argument that the increase in temperature during the last few decades of the twentieth century is caused by the sun, emphasizes why the reader should be skeptical of opinions expressed in blogs, op/ed pieces, letters-to-the-editor and newspaper reports such as those quoted

in Inhofe-400. Since there is no attribution to the scientific literature, the reader is left to his or her own devices to attempt to validate these claims.

While, there may be some science which supports contrarian views, it is difficult to find. Here are a few peer-reviewed journal articles which refute the contrarian view. This conclusion is confirmed by many studies quantifying the amount of solar influence in recent global warming:

> "We estimate that less than 15% of the 11-year cycle warming variations are due to cosmic rays and less than 2% of the warming over the last 35 years is due to this cause." (Sloan, 2007)
>
> "…over the past 20 years, all the trends in the Sun that could have had an influence on the Earth's climate have been in the opposite direction to that required to explain the observed rise in global mean temperatures." (Lockwood, 2007)
>
> Lockwood, 2007 concludes "the observed rapid rise in global mean temperatures seen after 1985 cannot be ascribed to solar variability, whichever of the mechanism is invoked and no matter how much the solar variation is amplified."
>
> Changes in the cosmic ray flux cannot be responsible for more than 15% of the recent warming. (Kirvova, 2003)
>
> Solanki, 2008 reconstructs 11,400 years of sunspot numbers using radiocarbon concentrations, finding "solar variability is unlikely to have been the dominant cause of the strong warming during the past three decades" (Solanki, 2008).
>
> "Although solar and volcanic effects appear to dominate most of the slow climate variations within the past thousand years, the impacts of greenhouse gases have dominated since the second half of the last century." (Ammann, 2007)
>
> "The variations measured from spacecraft since 1978 are too small to have contributed appreciably to accelerated global warming over the past 30 years." (Foukal, 2006)
>
> "since 1975 global warming has occurred much faster than could be reasonably expected from the sun alone." (Scafetta, 2006)
>
> "Observational data suggest that the Sun has influenced temperatures on decadal, centennial and millennial time-scales, but radiative forcing considerations and the results of energy-balance models and general circulation models suggest that the warming during the latter part of the 20th century cannot be ascribed entirely to solar effects." (Haigh, 2003)
>
> Stott et al. found increased climate model sensitivity to solar forcing and still found "most warming over the last 50 yr is likely to have been caused by increases in greenhouse gases." (Stott, 2003)
>
> Solanki 2003 concludes "the Sun has contributed less than 30% of the global warming since 1970". (Solanki, 2003)
>
> Lean 1999 concludes "it is unlikely that Sun–climate relationships can account for much of the warming since 1970".

> Waple, 1999 finds "little evidence to suggest that changes in irradiance are having a large impact on the current warming trend."

The solar argument to explain the recent warming is opined by at least 183 of the 400 “prominent scientists” cited in Inhofe-400. Yet there is not a single reference to the scientific literature to back up this claim. Whether or not this argument has any credibility the Inhofe-400 report contains no science in its respect, and critical thinking demands skepticism not of the IPCC report but the Inhofe-400 report.

The Hockey Stick

The IPCC AR-3 published in 2001, contained a curve showing the temperature anomaly during the last 1000 years as measured by proxies. The curve shows a relatively constant temperature, which solar scientists (Usoskin, 2007) have shown to be consistent with a solar insolation and other natural forcing functions, until the latter part of the twentieth century, when the Earth surface temperature has risen dramatically resembling a hockey stick shape. Contrarians have since then attempted to refute this curve. For example:

> “climate data analyst Stephen McIntyre of ClimateAudit.org, one of the individuals responsible for debunking the infamous ‘Hockey Stick’ temperature graph, exposed a NASA temperature data error in 2007 which led to 1934 -- not the previously hyped 1998 -- being declared the hottest in U.S. history since records began.” (Inhofe, 2007, page 41)

This passage from Inhofe, 2007 contains three mistakes. First, the Hockey Stick was never debunked by McIntyre or anybody else. The National Academy of Sciences confirmed the findings of the IPCC AR-3 (National Academy of Sciences, 2006).

The study by Usoskin et al. (Usoskin, 2005) cited above, finds that “the solar series shows a ‘Hockey Stick’ shape” confirming the Mann Hockey Stick (IPCC AR-3, 2001). Recently (Mann, 2008) further strengthened the proxy evidence and extends the reconstruction back nearly 2000 years.

Figure 5 shows the latest Holocene climate reconstruction from proxies. The Medieval Warm Period, roughly centered about 1000 A. D., and the Little Ice Age, roughly centered about 1700 A. D., are clearly visible. These events are generally attributed to a variation of solar insolation of about +/- 0.3 W/m^2, as described in the previous section (see also Shindell, 2001).

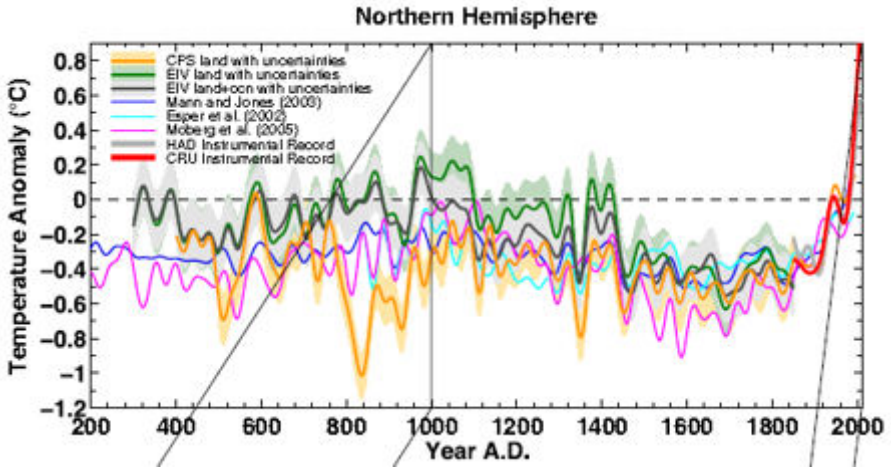

Figure 5 reconstructed surface temperature anomaly (Mann, 2008)

Second, the paragraph from Inhofe, 2007 cited above illustrates another contrarian confusion with respect to the exposure of "NASA temperature data error". Even the Wall Street Journal acknowledged that the error which McIntyre discovered, being only 0.03°C, was statistically insignificant in an editorial.

> "The recent discovery by a retired businessman and climate kibitzer named Stephen McIntyre that there was a minor error in the temperature data calibration did not impact the Earth temperature data in any statistically meaningful way…. I confess: I am prepared to acknowledge that Mr. McIntyre's discovery amounts to what a New York Times reporter calls a "statistically meaningless" rearrangement of data." (Stephens, 2007)

A third mistake in the contrarian arguments cited by Inhofe, 2007 above, was the subtle switch from global temperature to US temperature. 1934 was always known to be statistically tied with 1998 as the warmest year in the US both before and after the error was discovered. Many contrarians confuse some local temperature phenomena with global temperature phenomena in making their various claims.

Ironically, the hard and diligent work by McIntyre to examine every last detail of the consensus data sets strengthens the consensus view given that first, somebody is thoroughly investigating the data and second, that even statistically insignificant errors have been uncovered yet no important errors have been discovered.

The 70's ice age argument

> Justin Berk(Inhofe, 2007, page 94, newspaper article) "In the mid-1970s, climate experts said we were heading for an ice age. Thirty years later, they're saying global warming."

As discussed, this is not a scientific argument and it is not scientific skepticism. It reflects blind acceptance of the utterance of a fictional character in a book by Michael Crichton. Following the thread of this argument in the Inhofe 400 report is amusing and well as instructive.

Two of the “climate experts” who advocated for a pending ice age are Inhofe-400 listed contrarians Bryson, page 31 and Jaworowski, page 33. Evidence for the existence of such a consensus is apparently uncovered using the same flawed research techniques employed in the compilation of the rest of the Inhofe-400, namely avoiding citation to peer-reviewed scientific literature in favor of mainstream media.

> Glen Shaw (Inhofe, 2007, page 71, newspaper article) “In the 1970s as a young scientist at the Geophysical Institute I wrote passionate letters complaining that for the first time in the geologic era man was changing the atmosphere of the planet. I argued that continued dumping of carbon dioxide into the atmosphere would be associated with a warming of the entire Earth and pled for attention to this matter. The letters were ignored. They were ignored because in the 1970s, *Newsweek*, the *Christian Science Monitor*, the *New York Times*, and countless books and articles were warning of the dangers of global cooling.”

> Reid Bryson, (Inhofe, 2007, page 31, a blog) was pivotal in promoting the coming ice age scare of the 1970s (See Time Magazine's 1974 article "Another Ice Age" citing Bryson: & see Newsweek's 1975 article "The Cooling World" citing Bryson) has now converted into a leading global warming skeptic.

In summary, thirty years ago Bryson and a few others grabbed media attention warning the world of a pending ice age, a view not widely shared in the scientific community nor backed by strong scientific evidence. Today, these same scientists are denying AGW because previously scientists, themselves, alarmingly warned of the perils of an ice age which didn’t happen. Contrarians embrace this illogic because they unquestioningly accept the words of a fictional character.

The reason why this argument is not scientific even if it were true is easy to illustrate by example. During the 1970s the consensus view of paleontologists was that the dinosaurs went extinct gradually. It was not until the publication of the Alvarez paper in 1980, describing the Iridium spike at the Cretaceous-Tertiary rock sediment boundary, that the current consensus view, that the dinosaurs went extinct rather violently and catastrophically because of the collision of the Earth with a 10 km wide asteroid 65 million years ago, came to be accepted.

Nobody argues today that “first they told us in the 70s that the dinosaurs went extinct gradually and now they tell us that the dinosaurs went extinct suddenly”, to refute the collision hypothesis.

It’s the economy

> Computer modeler Donald DuBois (Inhofe, 2007, page 20): “Right now, climate science is a black box that is highly questionable with unstated assumptions and model inputs. It is especially urgent that these models come out in the open considering how much climate change legislation could cost the United States and the world economies.”

> Physicist John W. Brosnahan (Inhofe, 2007, page 27): “While there are any number of reasons to reduce carbon dioxide generation, to base any major fiscal policy on the role of carbon dioxide in climate change would be inappropriate and imprudent at best and potentially disastrous economic folly at the worst.”

> Physicist Zbigniew Jaworowski (Inhofe, 2007, page 33): “We thus find ourselves in the situation that the entire theory of man-made global warming-with its repercussions in science, and its important consequences for politics and the global economy-is based on ice core studies that provided a false picture of the atmospheric CO2 levels.”
>
> “We strongly warn against taking action using imminent climate catastrophe as a vehicle which will not be beneficial for our environment and will cause economic damage.” Biologist Ernst-Georg Beck; Engineer Paul Bossert; and others…(Inhofe, 2007, page 37).
>
> Meteorologist Robert Cohen (Inhofe, 2007, page 49): “Is it worth destroying our economy and lifestyle based on an unproven theory which does not correlate with historical observations?”
>
> Astronomer Ian Wilson (Inhofe, 2007, page 118): “the global economy will spend trillions of dollars trying to avoid a warming of ~ 1.0 K by 2100 A.D."
>
> Geologist Brian R. Pratt, (Inhofe, 2007, page 128) “stopping global warming has been adopted as a mission by people with the power to cause severe economic harm and divert efforts away from more critical measures involving conservation, population growth, poverty and so forth."
>
> Chemist Glenn Speck (Inhofe, 2007, page 145) “Those who want you to accept that humans have caused climate change have a not-so-hidden agenda of imposing carbon taxes here in the United States that will cripple our economy and make us even more unable to compete with other nations,”
>
> Chemist William L. Wells (Inhofe, 2007, page 148) “Restricting U.S. anthropogenic emissions, only a small part of the CO2 released into the environment, is a way of cutting off our economic noses to spite our faces."
>
> Richard Tol, (Inhofe, 2007, page 66) debunked the Stern review as “alarmist and incompetent.”

All of these opinions are proffered without attribution to any peer-reviewed study other than the Stern report (Stern, 2006) which convincingly contradicts them. These opinions reflect an ideology at odds with data, analysis and wisdom. Yet there are lots of reasons to be skeptical of these opinions besides lack of evidence.

1) The Bush administration has done everything to encourage consumption of fossil fuels, keep us out of the Kyoto protocols and block any proposal to regulate greenhouse gases. There could not have been a more perfect administration supporting the ideology of the scientists profiled in the Inhofe-400 report. Yet the US economy is currently facing an economic collapse unrivaled since the Great Depression. In order to justify the alarmist views cited in Inhofe-400, these contrarians are required to explain this discrepancy between reality and their opinions. The US rejected Kyoto, rejected control of CO2 emissions, deregulated energy companies and as a consequence caused exactly the economic collapse these pundits were alarmingly concerned about had we ratified Kyoto.
2) Several of the scientists cited in the Inhofe report, such as Paldor and Aleklett, point out that we are running out of fossil fuels. This problem may be a more serious threat to civilization than global warming in the near term. To address the very real

energy crises, we have no choice but to regulate CO2 emissions and use the remaining energy to transition to alternative sources of energy and subsidize conservation.

3) The Stern report argues credibly and persuasively that we need to invest about 1% of GDP on conservation and alternative energy sources in order to address AGW. Such expenditure would mitigate the energy crises which Paldor, Aleklett and others in the peak oil community warn us about. For perspective, this is equivalent to the money we've spent annually on the Iraq War. Unlike the Iraq War costs, expenditure on conservation and alternative energy would have been an investment in the future of the country which would have paid substantial dividends. If we accept the administration's justification for the war, then it was entirely unnecessary as there were no WMD, no ties to al Qaeda and Iraq had nothing to do with the attack on the US on 9/11/01. The Iraq War was an expense from which Americans derived no benefit yet cost us dearly in terms of lives, both American and Iraqi, as well as international leadership, prestige and credibility. This war contributed to our economic collapse. On the other hand, had we adopted Kyoto and instead invested the money in conservation, mass transportation and concentrated solar energy in the Mojave Desert we would have created jobs in America. We would have reduced our dependence on fossil fuels. And we would have investments which would continue to pay dividends long into the future. We would also have encouraged entrepreneurial talent to create exportable technology capable of mitigating our historically unprecedented trade deficits.

4) Had we adopted Kyoto and increased our mileage requirements for automobiles on par with Japanese requirements, GM might have invested in hybrid technology rather than the Hummer, which has been discontinued. GM might not be facing bankruptcy. Spending large sums of money lobbying against government regulation was not the only example of how the company was badly mismanaged, however.

In summary, these economic arguments are alarmist, unsubstantiated and quite disconnected from the evidence as well as being completely beside the point (they do not address the science described in the IPCC report).

Other arguments

> Owen McShane (Inhofe, 2007, page 70) "People generally seem not to be aware that the UN defines 'climate change' as only the effects of climate that result from human activity. It ignores the natural drivers that have governed the global climate for millions of years past". From a Newspaper article.

This is simply not true. McShane cannot have read the IPCC report because volcanism, solar irradiation, Croll-Milankovitch Cycles, the carbon-rock cycle and other carbon cycle feedbacks are all described.

> Rolf Riehm (Inhofe, 2007, page 58) "Allegedly the temperature of the earth has risen during the past 20 years by about 0.6° C."

In the past 20 years the temperature has risen 0.34^{o}C.

> David Archibald (Inhofe, 2007, page 79) "There is no correlation in the geologic record between atmospheric carbon dioxide and global temperature. The Earth went into an ice

age 450 million years ago despite a level of atmospheric carbon dioxide that is ten times what it is today," (personal paper – no peer-reviewed reference)

Actually, there is a correlation. Our sun is a 5 billion year old G2 star on the main sequence. 5 billion years ago the solar luminosity was about 70% of what it is today. Figure 6 compares the solar luminosity with the amount of Carbon Dioxide by volume which would have been required to maintain the Earth's temperature within a range necessary to support liquid water and the evolution of life. Note that more Carbon dioxide was required during the Archean, Proterozoic and early Phanerozoic to compensate for the weaker sun.

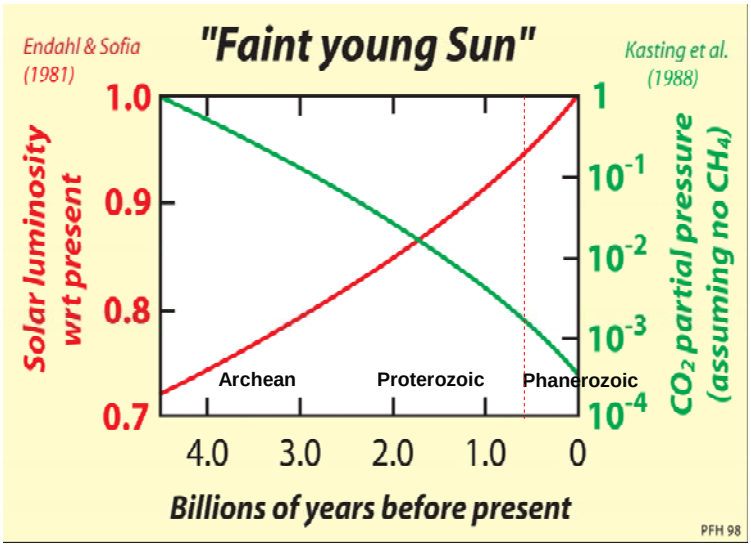

Figure 6 Solar luminosity and CO2 partial pressure.

Figure 7 plots the estimate of the atmospheric carbon dioxide levels during the Phanerozoic as well as amount of CO2 which would have been required to maintain the current surface temperature. Since we live during an ice age climate, carbon dioxide levels high above the red line in figure 7 correspond to hot house climates and levels at or below the red line would correspond to ice age climates. Note that the estimated atmospheric level of CO2 during the Early Phanerozoic 450 million years ago (Ma), referred to by Archibald, was about 8 times higher than today but about that much would have been required because of reduced solar irradiance. In other words, the glaciations experienced 450 Ma confirm the correlation between carbon dioxide level and the Earth's climate.

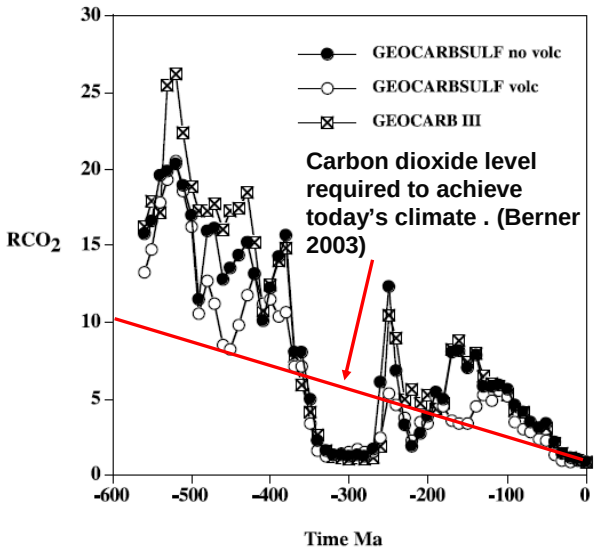

Figure 7 relative CO2 during the Phanerozoic

> Rob Roseman (Inhofe, 2007, page 90) "500 years ago, the Earth was about 5 degrees warmer than it is now"

This opinion is contradicted by another contrarian just two pages later.

> Dr. Charles Wax. (Inhofe, 2007, page 92) "There was a little ice age from 1400 to 1800."

Benestad, 2006, contains an excellent discussion regarding various estimates for the duration of the “little ice age” but the entire period from 1250 to 1850 was a cold period for the Earth’s climate. In this case, Wax is correct and Roseman is simply wrong.

> Brian G. Valentine (Inhofe, 2007, page 93) “My own research has convinced me that excepting for one situation, there have NEVER been ANY influences that have changed the global climate - not solar, not stellar, not variations in Earth's spin on its axis - nothing - that can be demonstrated beyond reasonable doubt, for which equally valid evidence is available that contradicts the assumption of global climate change," Valentine explained. "This single exception is the known variation of eccentricity of the Earth's orbit about the Sun. This is the periodic variation of distance from Earth to the Sun that changes the distance from the Earth to the Sun within Earth's seasons, and occurs within tens of thousands of year epochs," he concluded. *(Note: Valentine is expressing his personal views.)*

Since most of the contrarians make a big deal out of solar influence on the Earth’s climate (and rightly so) Valentine’s opinion contradicts whatever consensus there might be among contrarians. As a matter of fact, The Earth’s orbit varies with three known periodicities: eccentricity, with a period of approximately 100,000 years; axis of rotation tilt angle or obliquity with a period of approximately 41,000 years; and axis wobble or precession with a period of approximately 23,000 years. All three are shown to play an important roll in the Earth’s climate during the Pleistocene (Crowley, 2008 and Huybers, 2006). James Croll, in 1860, proposed that the Earth’s orbital variations were the cause of the ice ages. This in fact is correct, but Croll assumed that

maximum glaciations would occur at maximum eccentricity because this would lead to coldest winters over the northern hemisphere. Croll included surface albedo as a feedback function. Milutin Milankovitch redid Croll's calculations but assumed that maximum glaciations would correspond to colder summers in the Northern hemisphere and came closer to the mark. When carbon cycle feedbacks were later added to the theory by Berger (1988), good agreement was achieved between orbital variation and ice extent (see, Bradley, 1999). Valentine's opinion is so far out of the mainstream that even the Inhofe authors were moved to add the parenthetical qualifying statement.

> Gary Novak (Inhofe, 2007, page 93, quoted from a blog) "Arctic ice is melting faster than expected, because oceans are heating more than the atmosphere. No atmospheric temperature increase has been found in eight years. Alarmists are not promoting science; they are promoting propaganda justified through a black-box analysis which generates contrived numbers. Science requires evidence and logic," Novak, who holds a masters degree in microbiology, wrote on his website in 2007. "There is no mechanism for carbon dioxide creating global warming. 'Greenhouse gases' absorb all radiation available to them in a few meters. More of the gas cannot absorb more radiation. A thick sheet of plastic does nothing more than a thin sheet. Doubling the CO2 would only shorten the distance for absorption of radiation from 10 meters to 5 meters, which is not an increase in temperature," Novak explained. "The real cause of global warming could be an increase in solar energy, as critics generally claim; but there is evidence that it is due to variations in heat from the earth's core. Ice ages are caused by oceans heating, which appears to result from increased heat from inside the earth. The primary evidence is the exact cycling of ice ages. Environmental factors would not be so precise. Also, the oceans heating more than the atmosphere points to the heat coming from inside the earth. Atmospheric changes can result from variations in solar activity, but they are superficial compared to heat from the earth's core which drives ice age cycles," he concluded.

Novak's opinions are also far outside the mainstream not just of the consensus view but also the contrarian view. See the discussion above with respect to Valentine. In fact orbital variations are pretty precise.

> Ray Kurzweil (Inhofe, 2007, page 100) "I don't see any disasters occurring in the next 10 years from this. However, I am concerned about other environment issues. There are other reasons to want to move quickly away from fossil fuels including environmental pollution at every step and the geopolitical instability it causes," he concluded.

Kurzweil's opinion is actually more in line with the consensus view than the contrarian view. It is not clear how he makes it into this report.

> Christopher L. Castro, (Inhofe, 2007, page 102), expressed skepticism of a global warming catastrophe in 2007. "I believe the balance of evidence from the paleoclimate record, recent climate history (particularly since the 1980s), and the anthropogenic attribution GCM (Global Climate Models) experiments (e.g., Meehl et al. type studies) support the conclusion that recent climate change is due, in part, to anthropogenic forcing," Castro wrote on June 4, 2007. But Castro also said he generally agrees that

> "other possible forcings to the climate system besides CO2 (like land-use change, aerosols, etc.) are not accounted for well, if at all"

This is hardly a contrarian view. One gets the impression that Castro, and Kurzweil, like Paldor and Aleklett, and many others, were added to the Inhofe-400 report, in order to give it an appearance of "heft" to any reader who doesn't actually read it too carefully.

Conclusions

Never before in human history have so many scientists and other experts cooperated on an important issue to organize and examine the available science. The IPCC reports are a remarkable human accomplishment. The breadth and depth of the experiences and expertise of the authors and reviewers is unparalleled. Nevertheless, like all human endeavors, it is appropriately subject to legitimate skepticism and criticism from both those who might believe it is too pessimistic and those who might believe it is too optimistic.

A far criticism can be made that there may not be enough recoverable fossil fuel resources to achieve the worst case scenarios in the IPCC, 2007 report. One the other hand, a fair criticism can be made that positive carbon cycle feedback, such as from land use, permafrost or methane hydrates melting, have not been adequately accounted for. In either case, humankind needs to wean itself off of fossil fuels and develop alternative, sustainable, energy resources as soon as possible, either before these precious fuels run out or before we've irreparably fouled our environment by burning too much of them.

The idea that free market capitalism without regulation and government intervention can solve these energy and environmental problems is ludicrous in the face of the current economic crises. Alan Greenspan testified before the House Committee on Government Oversight and Reform on October 23rd: "those of us who have looked to the self-interest of lending institutions to protect shareholder's equity (myself especially) are in a state of shocked disbelief." Not only is self-interest not a sufficient motivation for free markets to solve global economic, energy and environmental problems, free market self-interest cannot even protect stockholder value. In view of the economic meltdown and what should be the repudiation of the efficient market hypotheses, we might conclude that it is hard to find an economist who understands the economy let alone anthropogenic global warming. Or, if we cannot find an economist who understands the economy, why would we expect to find a scientist who does? This contrarian economic argument against taking positive action in the face of these overwhelming energy and environmental challenges because it might hurt the economy is astounding.

There might be some scientific legitimacy to some of the claims of contrarians, but this has never been demonstrated in the scientific literature. The Inhofe-400 report makes perfectly clear that these views are limited to op/ed pieces, blogs, letters-to-the-editor and other sources which have no scientific content or verifiability.

The inability of Inhofe-400 report authors to find peer-reviewed science to back up their views further reinforces the consensus view of the IPCC, 2007 report. To put another way, while the IPCC report is worthy of scientific skepticism, the Inhofe-400 report is not worthy of the time it takes to down load it off the Internet.

The Inhofe, 2007 report also makes very clear that there is no self-consistent, testable 'contrarian theory' of climate. What is it that these people believe? I can only surmise that the bulk of contrarian views are driven by an opposition to regulation of free market and have nothing to do with good science.

Inhofe's references

Madhav Khandekar, (Inhofe, 2007, page 43) wrote in a May 28, 2007 letter to the editor of Canada's The Hill Times. "...Adherents of the IPCC science like to insist that the debate over climate change science is over and it is now time for action. I urge [those IPCC supporters] to browse through recent issues of major international journals in climate and related science. Hardly a week goes by without a significant paper being published questioning the science," Khandekar added.

This then is the salient problem with the contrarian view. There is expressed within the Inhofe-400 report the opinion that the science exists which supports their views but that science, if it actually exists, is never presented. If it does exist, why not simply present that than a bunch of unsubstantiated opinions?

In 175 pages, the Inhofe-400 authors could only indirectly cite 14 peer-reviewed scientific journal articles, one of which does not exist and 5 of which contradict the Inhofe-400 ideology. In 29 pages, I've cited 55 credible references. I'm well aware of the possible charge that since I am not a climate physics expert, my selection of peer-reviewed papers may be biased. Perhaps, but it was precisely with this possible criticism in mind that I read the Inhofe-400 report in the first place hoping to discover a scientific basis of AGW contrarianism. I was disappointed.

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