

John Menke
22500 Old Hundred Rd
Barnesville, MD 20838
301-407-2224
john@menkescientific.com

Global Warming--Poppycock?

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Introduction

There continues to be a strong element of doubt concerning global warming. In the face of almost universal scientific acceptance of the impending problem, many people (including of course, some scientists) continue to express doubt. I would note that virtually all the positive evidence and analysis for global warming has come from the scientific establishment, which means it has been peer reviewed and criticized, and exposed to multiple challenges and verifications by other scientists. On the contrary, almost all of the opposing views are essays, reports, blogs, etc that express a particular set of opinions, and were NOT subject to anything like the same process of criticism.

Many people seem to believe that the scientific establishment blocks criticism. Unfortunately, this does happen, but not nearly as often nor as badly as critics think. One should remember that one of the great marks of success for a scientist is to take on a sacred cow and debunk it: there are Nobel prizes to be won! Every day, scientific knowledge is corrected (ie, someone was shown to be wrong or incomplete) and conclusions changed as we converge on the truth. But that same self correction virtually NEVER occurs in the non-scientific community. In fact, even when a factual error or misstatement is pointed out (as this paper does), passionate critics (as in the anti-global warming debate) often just continue the error.

We need also to remember that there are literally countless ways accidentally or on purpose to use data to lead to incorrect (i.e., untrue) conclusions. There is no way that the scientific community can ever respond totally to every single claim--we must rely on the basic scientific method to do that, and know that some people will refuse to be convinced, no matter what the evidence. Never the less, this paper will deal with several of the current claims that the scientists are wrong about global warming.

A Little Background Physics

The earth, if it had no atmosphere, would be at an average temperature like the moon, of about -20C, but would have wild swings of day night temperature as well as latitude variations.

The sun emits radiant energy, as do all material bodies. The sun is hot--its radiant energy is visible, short wave length. The earth also radiates energy, but because it is relatively

cool, the earth's radiation is invisible (to us) and is long wavelength. If the earth radiates away as much energy as it receives, then its temperature is stable.

A planet atmosphere could be essentially transparent to all wavelengths of light. The average temperature would then be the same, but the spatial and time variations would greatly decrease. However, the earth's current atmosphere does have a substantial greenhouse effect--it is relatively more transparent to the sun's short wave radiation energy coming in, than it is to the earth's long waves going out, i.e., outgoing radiation is partially blocked. The temperature of the earth (and the atmosphere) then rises so that the radiant energy of the earth shortens its wavelength slightly, reducing the atmospheric blockage, until the energy out equals the energy in from the sun, thus producing a stable temperature. The amount of earth temperature rise due to greenhouse is about 45C.

Most of the greenhouse effect is due to the water vapor in the atmosphere. In fact, there is so much water vapor that the effect of the water vapor is almost maxed out. That is, more water vapor by itself would not increase temperature very much. That is not the case with CO₂ (and what are normally called other greenhouse gases such as methane). CO₂ levels in human times have been at about 285ppm (now it is about 370ppm) and is not maxed out: increases in CO₂ do produce increases in temperature (other things being equal).

The amount of CO₂ in the atmosphere depends on the relative amounts that are emitted (source) into the atmosphere, and the amount lost (sink). Sources include plant decomposition, animal life, human activity and fuel burning, volcanoes and so on. Sinks include plant growth, dissolving in oceans, etc. The net CO₂ in the air is the balance of these effects, including the effects of recent history (the system is slow to respond to increases or decrease in sources and sinks). The amount of non-human CO₂ sourced and sunk is about 200 Gigatons/yr, while human fuel burning is about 10 GT/yr.

Note, I use the term CO₂ as a surrogate for all greenhouse gases (excluding water vapor).

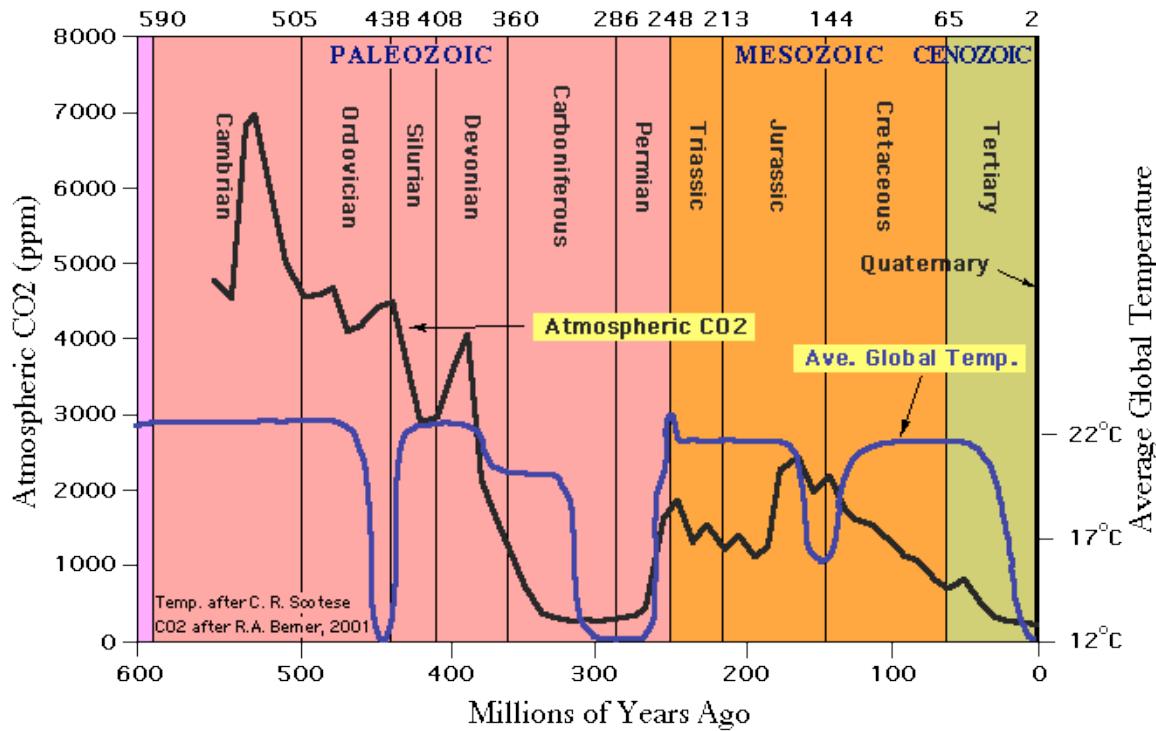
Anti-Global Warming Claims

Claim 1: CO₂ was high in earlier times, but temperatures were low--CO₂ doesn't cause warming. There are many effects on climate, and many "natural cycles" of which we are ignorant--we are just in one of them.

Response: It all depends on the timetable. Here is a graph of CO₂ and temperature over the last 500 million years showing that CO₂ and temperature vary all over the place. The history of the earth does include long times when CO₂ was high but temperatures were low. Note that the CO₂ level has been as high as 7000ppm (20 x our current level)!

Does that invalidate our current conclusion that higher CO₂ will likely lead to higher temperatures? No, it does not. The climate, indeed, the very composition of the atmosphere, depends not only on the obvious geology and astronomy (solar intensity and the like), but on the presence and extent of plant life. The earth's atmosphere has free

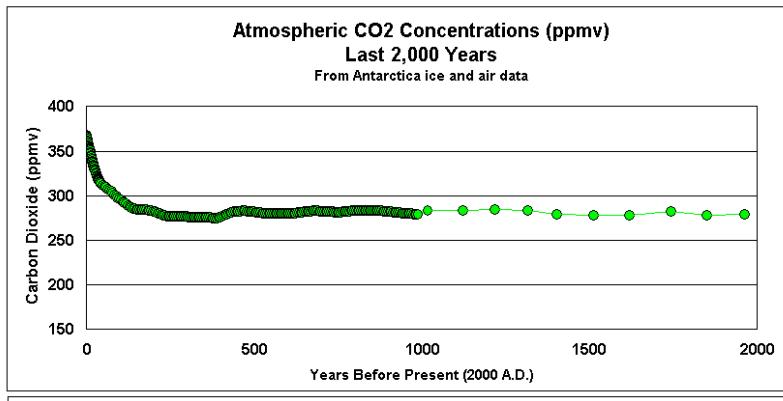
oxygen only because of plants, and the relative amounts of all the gases depends on the interaction of all things present and its recent history. Thus, the amount of greenhouse warming depends on the dynamic mix of all these effects (plants, ice, water, atmosphere constituents). One cannot simply compare conditions today, and how the climate works, with the very different conditions millions, much less, hundreds of millions of years ago: to do so is to make a false comparison.



Claim 2. CO₂ levels go up and down--our current trend upward is natural, and not man-made.

Take a look at the next graph. This shows CO₂ levels for the last 2000 years (early data are from air bubbles taken from ice cores).

Notice that the level is constant at about 270ppm until the last 150 years or so when it began rising fast (you can go back 20,000 years and see much the same thing). This increase in CO₂ level is beyond dispute. The question is it man made or natural?



Many people have looked hard at natural processes to answer this question, however, there is no known natural process that could have done this, especially on such a short time scale. We can eliminate all earth processes (volcanoes, etc) and we can find no evidence that the sun has caused this. But we can correlate this with fossil fuel use by humans, where we KNOW we are adding CO₂ to the atmosphere as shown in the graph (four-fold increase since 1950). The correlation does not prove cause and effect, but is very suggestive.

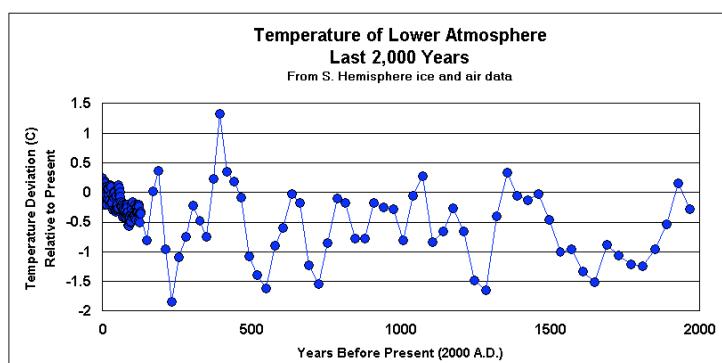
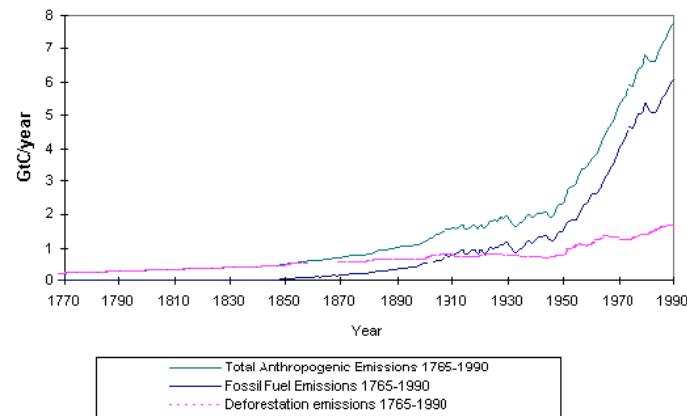
But there is even stronger evidence that the increase in CO₂ is manmade. Fossil fuels, because they are from plants that have been secreted away underground for millennia, have a slightly different isotope mixture as compared to above ground CO₂ generators (plants, plankton, etc) and even volcanic CO₂. If one checks the trend of the isotopic

mixture of CO₂ in the air, one finds that it is trending toward the fossil fuel ratios, i.e., a major part of the increase in modern CO₂ level is definitely from fossil fuel burning, i.e., man made. There is no other plausible explanation. Critics keep ignoring all this work.

Claim 3-the earth's temperature varies all over the place, and we don't yet see a clear increase, so global warming claims are overstated.

Yes, temperatures do vary: look at the next graph. The temperature during the last 150 years is trending upward, but not very differently from some other times in the last 2000 years. But the claim that the lack of a marked temperature increase has not happened, so global warming is a farce, is a red herring. Virtually all

responsible scientists recognize that measuring temperature of the earth is difficult. Temperature is measured at one place at a time, so how do you average over the earth, or even above the earth (the above graphs is for lower atmosphere



temperature--there is also earth temperature, upper atmosphere temperature, northern hemisphere vs. southern hemisphere, etc. And effects local to the thermometer affect the result (urban heat islands, for example). How do we accurately correct for those effects, especially on measurements from 200 years ago? And which measure is best to represent

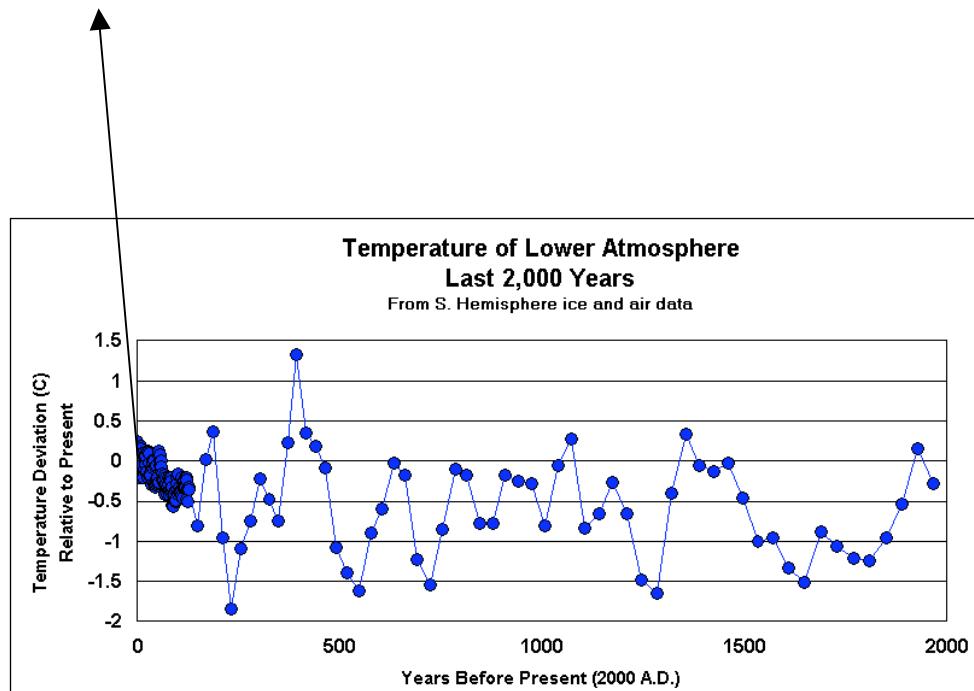
global warming? It is these difficulties that caused many of us scientists to be skeptical about the claims of global warming (or cooling).

However, in contrast, CO₂ largely is averaged out in the atmosphere, so one can in fact measure a pretty representative value, and then use our knowledge of the physics of the atmosphere to predict the likely climate effects, averaged over the earth (or at least, over large areas). And the ice core data have given us a very good way of knowing CO₂ over long historical periods.

Most current global warming models show that at present CO₂ levels, the amount of warming is at or below one degree, and is almost impossible to measure. The global warming issue is not that we have had much to date, but that the amount that is coming IS big, and when it comes, it will be too late to reverse it.

The CO₂ trend is upward, but will it continue to rise? It will keep rising because we are burning more energy, there are more people, standards of living are rising, and in fact the atmosphere is almost surely "behind" the curve. That is, we do emit mostly to the atmosphere, but some of the CO₂ goes into the ocean, forest, etc. If one looks at the various "sink" processes, the conclusion is that many are being maxed out, i.e., in the future, more of the emitted CO₂ will stay in the atmosphere, making things worse.

When one does extend the trend of increasing CO₂ into the next century, we predict that the temperature will rise a likely 4-8deg or so, i.e., way, WAY off the chart. There is no known event in the historical record of natural events that duplicates anything like that degree and speed of temperature increase. Repeat, this has no precedent. And that is the challenge of Global Warming.



Claim 4: CO₂ is only (pick a number) 0.5% of natural warming from water vapor, so is inconsequential.

I have been unable to find exactly where this claim comes from. However, we can see that while the arithmetic of this or similar claims may be correct on the face of it, to conclude that CO₂ is a trivial effect is to draw a false conclusion. An analogy: the average sea level is about 5000ft, therefore, a sea level rise of 50 feet (only 1%) is completely trivial, and would cause no problem! Obviously, this is false.

What is happening is that water vapor DOES account for most of the earth's warming, but as noted, is largely maxed out in its effect. The addition of CO₂ effects may be small relative to the water vapor, but it is more than enough to threaten human conditions of life. Widespread changes across the world in the ability to grow crops and provide drinking water can arise from small relatively changes in climate. In our own small Maryland experience, with 33 inches of rain a year, a few years of just 20% less rain wrecks havoc on agriculture, water budgets, etc. If one extends that over entire continents, as the physics predicts will happen, we are into world wide turmoil. Ironically, even those areas that might see climate "improvements" will also be in turmoil as they learn how to use the increased rain or growing conditions, and as they cope with others want to migrate there.

Computing a comparison of CO₂ to water vapor, and claiming that the small ratio shows this to have a trivial effect, is to make a false conclusion.

Claim 5: Only (pick a number) 5% of the increase in CO₂ is anthropogenic (ie, it's not us!).

Again, I cannot find a source for this number. And as noted above, there is plenty of direct evidence that the CO₂ increase IS in fact manmade. However, I think what the claimants have done in this ratio argument is to compare apples and oranges: they have taken the manmade CO₂ and divided it by the entire carbon flux (total of the sources).

Yes, one can do the arithmetic, but so what? What counts is that there was a balance for many tens of thousands of years in the average sources and sinks which resulted in an atmospheric balance steady at about 280ppm. The addition of fossil fuel burning has tipped that balance into an increasing atmospheric concentration. It is the increasing concentration that drives the climate change, not the particular ratio of annual human vs. natural which has nothing directly to do with climate (except that we are tipping the balance).

Calculation of ratios and proportions is important to seeing the relationships between variables; however, the ratios must connect logically to the problem, or they will be misleading.

Claim 6: Goodness, we burned all that dirty fuel in the last century and we've all cleaned up our act. Why are we only now seeing the global warming argument?

First note that CO₂ emission from fossil fuel use and forest clearing today is far, far higher than even just 50 years ago (x4), as shown in the graph above. Beyond that, it is true that the burning in the past centuries was done very poorly, very inefficiently, and very smokily. We have cleaned that up, partly by better design burners and pollution control, and partly by using fuels that are easier to burn cleanly (gasoline, natural gas). But while the cleanup has removed dangerous particulates from the air, we have vastly increased our CO₂ output. We are now far more energy intensive (more fossil fuel BTUs and forest removal and CO₂ per person) and we have more population (six-fold since 1850, and will be nine-fold by 2050).

Conclusion

At this time, (unfortunately) we are not in the worst case. We have a very large portion of the earth's population living in poverty, with low fossil fuel use. As they increase even modestly their standard of living, there will be a huge (x4-8 or more) increase in fuel use following current practices. This will vastly overwhelm any reduction in CO₂ emissions we are able to achieve in the "west". In fact, even if the developing world were to become as low in emitting CO₂ as we think we can do in the west, the populations are so huge that total emissions of CO₂ will still be x2-3 higher than they are now. Hence my own pessimism about mitigating the effects of global warming.