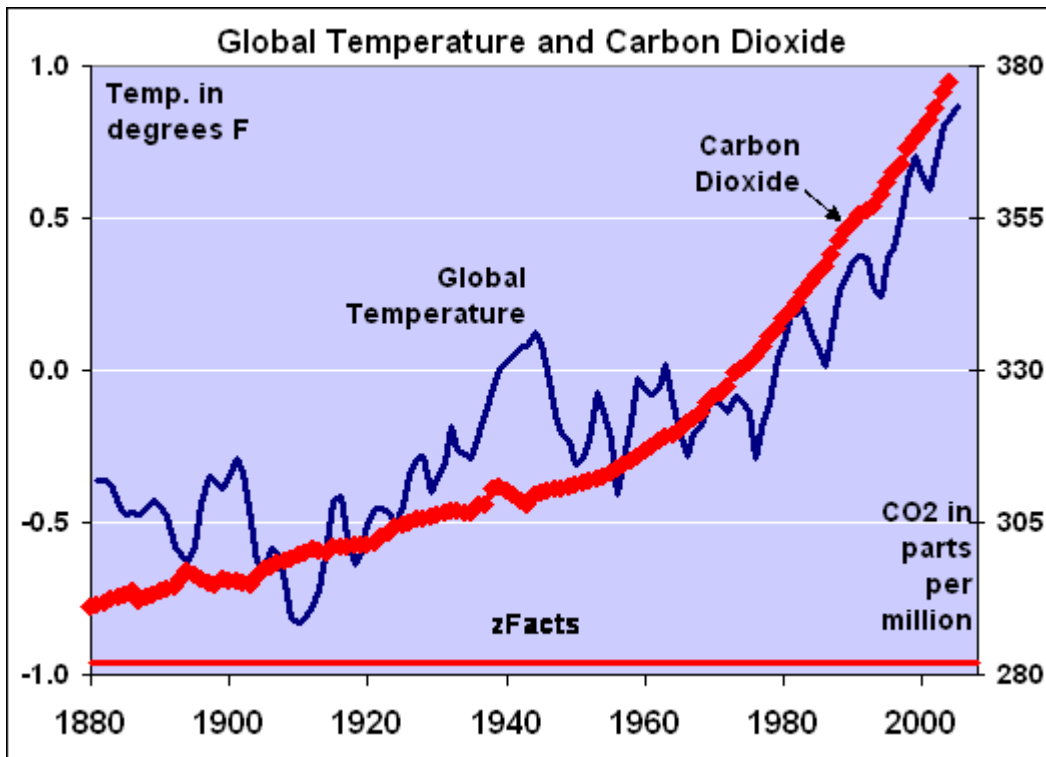


A study: The temperature rise has caused the CO₂ Increase, not the other way around

Posted on [June 9, 2010](#) by [Anthony Watts](#)

Guest post by [Lon Hocker](#)



A commonly seen graph illustrating what is claimed to be a causal correlation between CO₂ and temperature, with CO₂ as the cause. (Image courtesy Zfacts.com)

Abstract

Differentiating the CO₂ measurements over the last thirty years produces a pattern that matches the temperature anomaly measured by satellites in extreme detail. That this correlation includes El Niño years, and shows that the temperature rise is causing the rise in CO₂, rather than the other way around. The simple equation that connects the satellite and Mauna Loa data is shown to have a straight forward physical explanation.

Introduction

The last few decades has shown a heated debate on the topic of whether the increase of CO₂ in the atmosphere is causing rising temperatures. Many complex models have been

made that seem to confirm the idea that anthropological CO₂ is responsible for the temperature increase that has been observed. The debate has long since jumped the boundary between science and politics and has produced a large amount of questionable research.

“Consensus View”

Many people claim that anthropological CO₂ is the cause of global warming. Satellite temperature data, <http://vortex.nsstc.uah.edu/data/msu/t2lt/uahncdc.lt>, and Mauna Loa CO₂ measurements, ftp://ftp.cmdl.noaa.gov/ccg/co2/trends/co2_mm_mlo.txt, are well accepted and freely available to all researchers. Figure 1 shows a plot of the Ocean Temperature Anomaly from the satellite data shows a general rising trend. Shown along with the temperature data is a simple linear model showing the temperature rise as a linear function of CO₂ concentration. This shown linear model is:

$$\text{Temperature Anomaly} = (\text{CO}_2 - 350)/180$$

No attempt has been made to optimize this model. Although it follows the general trend of the temperature data, it follows none of the details of the temperature anomaly curve. No amount of averaging or modification of the coefficients of the model would help it follow the details of the temperature anomaly.

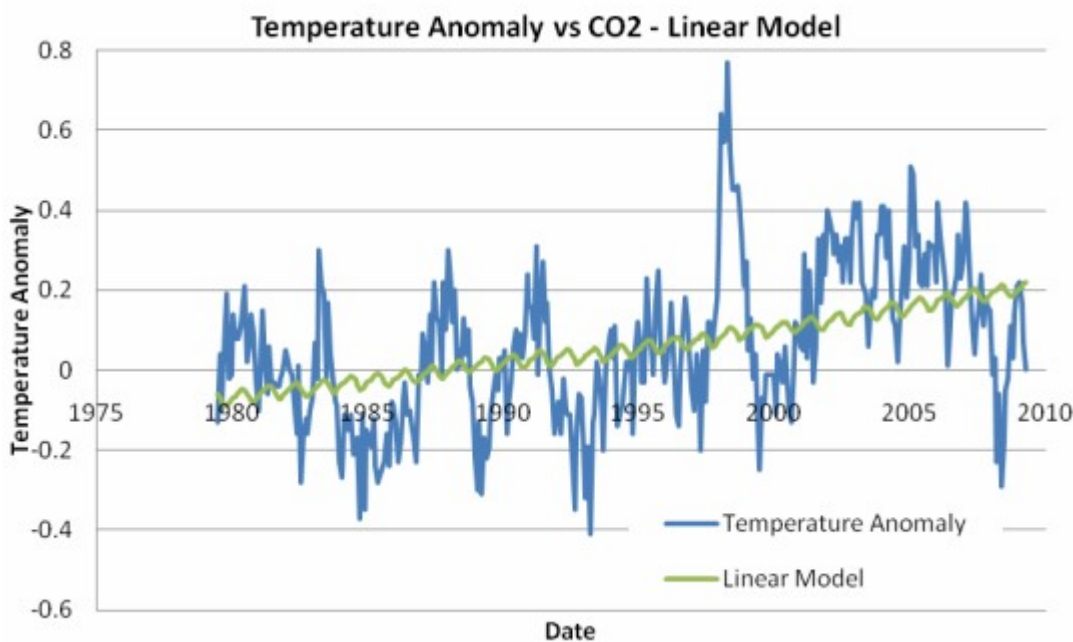


Figure 1: Ocean Temperature Anomaly and linear CO₂ model

Derivative approach

An alternate approach that does show these details is that the temperature anomaly is correlated with the *rate of increase* of CO₂. I discovered this independently and roughly simultaneously with Michael Beenstock and Yaniv Reingewertz

http://economics.huji.ac.il/facultye/beenstock/Nature_Paper091209.pdf.

Applying this model to the Mauna Loa data not only shows the overall trend, but also matches the many El Niño events that have occurred while satellite data has been available. The Figure 2, shows the derivative model along with the observed Ocean Temperature Anomaly. The model is simply

$$\text{Temperature Anomaly} = (\text{CO}_2(n+6) - \text{CO}_2(n-6)) / (12 * 0.22) - 0.58$$

where 'n' is the month. Using the n+6 and n=6 values (CO₂ levels six months before and six months after) cancels out the annual variations of CO₂ levels that is seen in the Mauna Loa data, and provides some limited averaging of the data.

The two coefficients, (0.22 and 0.58) were chosen to optimize the fit. However, the constant 0.58 (degrees Celsius) corresponds to the offset needed to bring the temperature anomaly to the value generally accepted to be the temperature in the mid 1800's when the temperature was considered to be relatively constant. The second coefficient also has a physical basis, and will be discussed later.

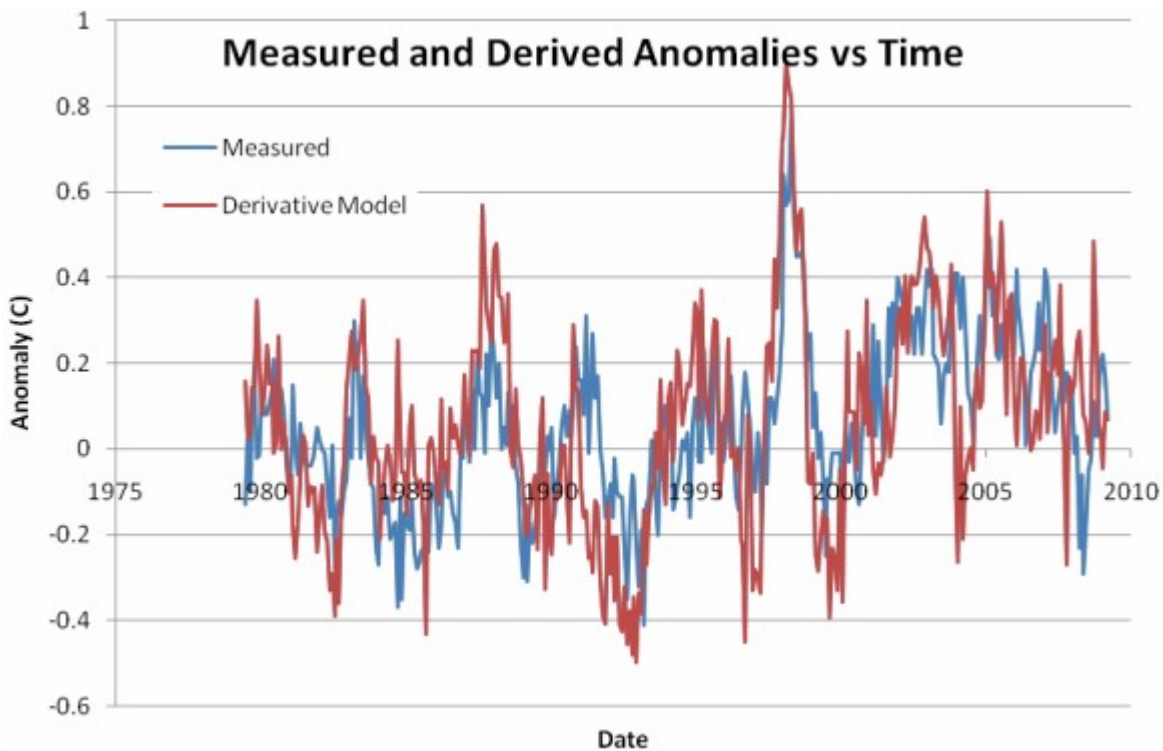


Figure 2: Ocean Temperature Anomaly and derivative CO2 model

There is a strong correlation between the measured anomaly and the Derivative model. It shows the strong El Niño of 1997-1998 very clearly, and also shows the other El Niño events during the plotted time period about as well as the satellite data does.

Discussion

El Niño events have been recognized from at least 1902, so it would seem inappropriate to claim that they are caused by the increase of CO₂. Given the very strong correlation between the temperature anomaly and the rate of increase of CO₂, and the inability to justify an increase of CO₂ causing El Niño, it seems unavoidable that the causality is opposite from that which has been offered by the IPCC. The temperature increase is causing the change in the increase of CO₂.

It is important to emphasize that this simple model only uses the raw Mauna Loa CO₂ data for its input. The output of this model compares directly with the satellite data. Both of these data sets are readily available on the internet, and the calculations are trivially done on a spreadsheet.

Considering this reversed causality, it is appropriate to use the derivative model to predict the CO₂ level given the temperature anomaly. The plot below shows the CO₂ level

calculated by using the same model. The CO₂ level by summing the monthly CO₂ level changes caused by the temperature anomaly.

$$\text{Month}(n) \text{ CO}_2 = \text{Month}(n-1) \text{ CO}_2 + 0.22 * (\text{Month}(n) \text{ Anomaly} + 0.58)$$

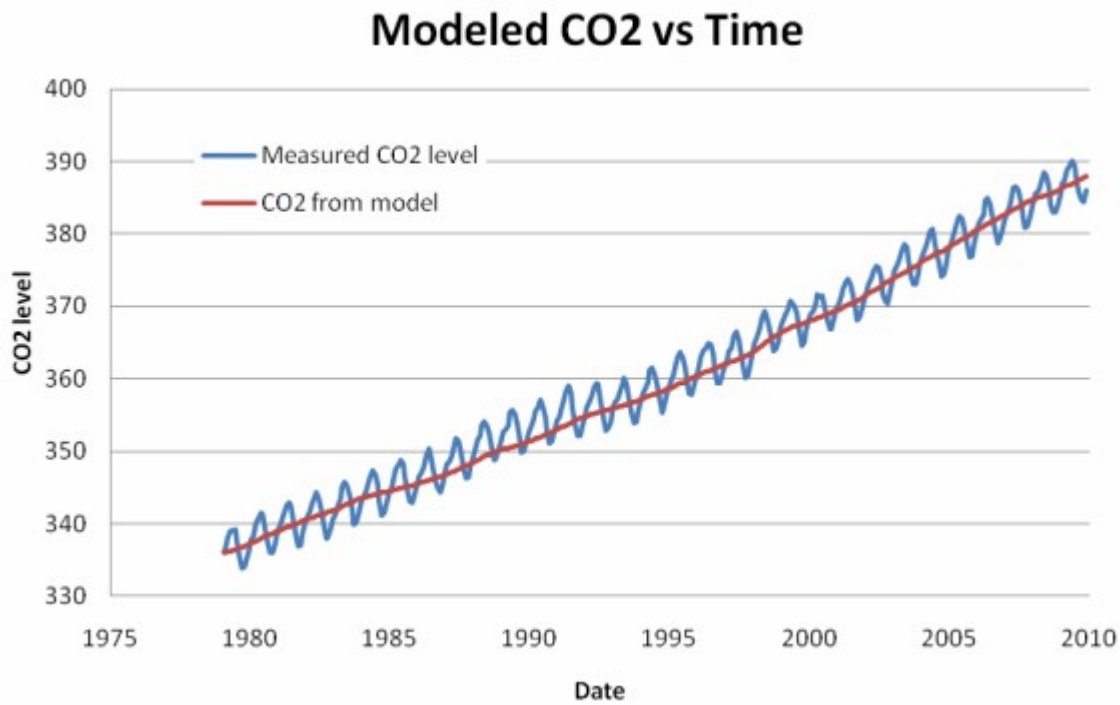


Figure 3: Modeled CO₂ vs Observed CO₂ over Time

Not surprisingly the model tracks the CO₂ level well, though it does not show the annual variation. That it does not track the annual variations isn't particularly surprising, since the ocean temperature anomaly is averaged over all the oceans, and the Mauna Loa observations are made at a single location. Careful inspection of the plot shows that it tracks the small inflections of the CO₂ measurements.

The Mauna Loa data actually goes back to 1958, so one can use the model to calculate the temperature anomaly back before satellite data was available. The plot below shows the calculated temperature anomaly back to 1960, and may represent the most accurate available temperature measurement data set in the period between 1960 and 1978.

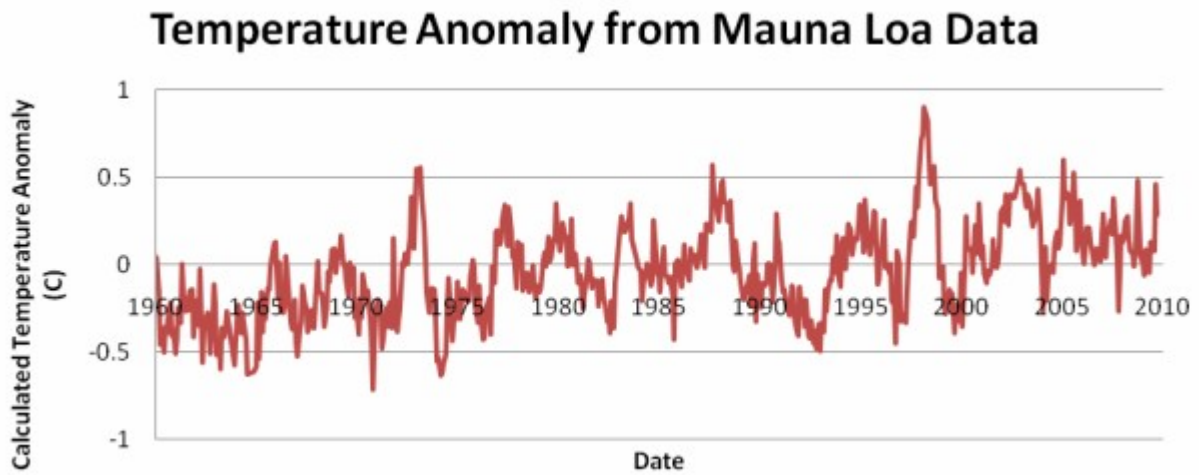


Figure 4: Calculated Temperature Anomaly from MLO CO2 data

Precise temperature measurements are not available in the time period before Satellite data. However, El Niño data is available at http://www.cpc.noaa.gov/products/analysis_monitoring/ensostuff/ensoyears.shtml making it possible to show the correlation between the calculated temperatures and the and El Niño strength. Note that the correlation between temperature anomaly and El Niño strength is strong throughout the time span covered.

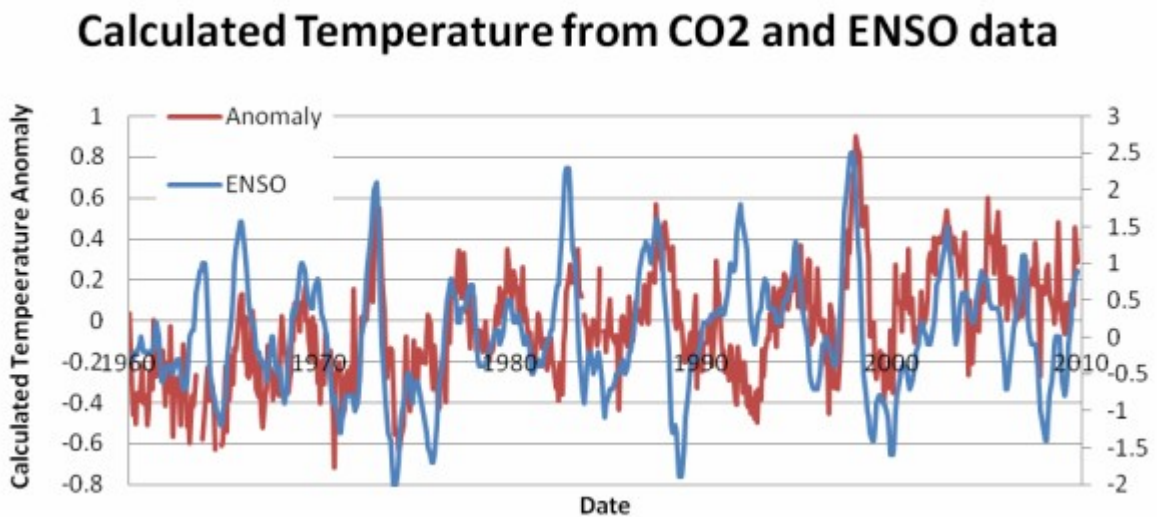


Figure 5: Calculated Temp CO2 from CO2 and ENSO data

An Explanation for this Model

The second free parameter used to match the CO₂ concentration and temperature anomaly, 0.22 ppm per month per degree C of temperature anomaly, has a clear physical basis. A warmer ocean can hold less CO₂, so increasing temperatures will release CO₂ from the ocean to the atmosphere.

The Atmosphere contains 720 billion tons of CO₂

(http://eesc.columbia.edu/courses/ees/slides/climate/carbon_res_flux.gif), the ocean 36,000 billion tons of CO₂. Raising the temperature of the ocean one degree reduces the solubility of CO₂ in the ocean by about 4%

(http://www.engineeringtoolbox.com/gases-solubility-water-d_1148.html)

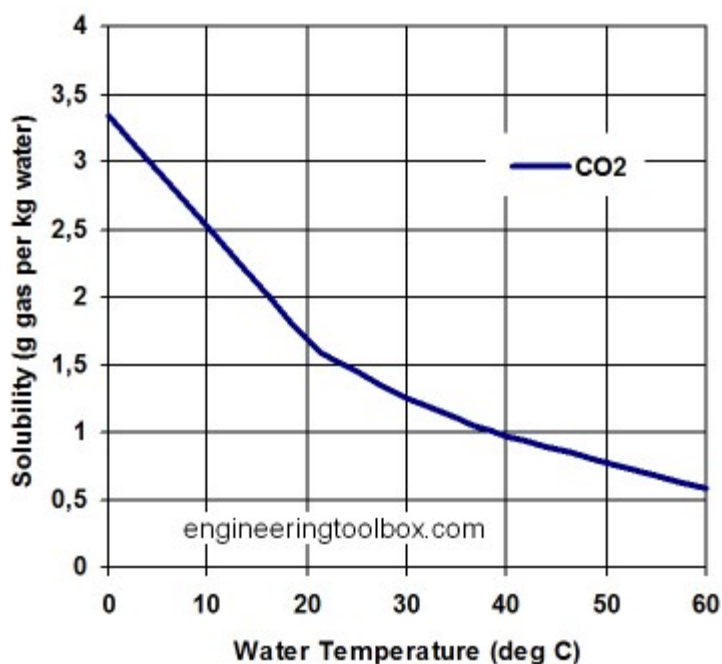


Figure 6: Solubility of CO₂ in water (While CO₂ solubility in seawater is slightly different than in pure H₂O shown above in Figure 6, it gives us a reasonably close fit.)

This releases about 1440 billion tons of CO₂ to the atmosphere. This release would roughly triple the CO₂ concentration in the atmosphere.

We have seen what appears to be about a 0.8 degree temperature rise of the atmosphere in the last century and a half, but nowhere near the factor of three temperature rise. There is a delay due to the rate of heat transfer to the ocean and the mixing of the ocean. This has been studied in detail by NOAA,

http://www.oco.noaa.gov/index.jsp?show_page=page_roc.jsp&nav=universal, and they

estimate that it would take 230 years for an atmospheric temperature change to cause a 63% temperature change if the ocean were rapidly mixed.

Using this we can make a back of the envelope calculation of the second parameter in the equation. This value will be approximately the amount of CO₂ released per unit temperature rise (760 ppm/C) divided by the mixing time (230 years). Using these values gives a value of 0.275 ppm /C/month instead of the observed 0.22 ppm/C/month, but not out of line considering that we are modeling a very complex transfer with a single time constant, and ignoring the mixing time of the ocean.

Conclusion

Using two well accepted data sets, a simple model can be used to show that the rise in CO₂ is a result of the temperature anomaly, not the other way around. This is the exact opposite of the IPCC model that claims that rising CO₂ causes the temperature anomaly.

We offer no explanation for why global temperatures are changing now or have changed in the past, but it seems abundantly clear that the recent temperature rise is not caused by the rise in CO₂ levels.

=====