

Temperature Drives Atmospheric CO2 more than CO2 Drives Temperature

Temperature, among other factors, drives atmospheric CO₂ much more than CO₂ drives temperature. The rate of change dCO_2/dt varies ~contemporaneously with temperature, which reflects the fact that the water cycle and the CO₂ cycle are both driven primarily by changes in global temperatures (Veizer et al).

To my knowledge, I initiated in January 2008 the hypothesis that dCO_2/dt varies with temperature (T) and therefore CO₂ lags temperature by about 9 months in the modern data record, and so CO₂ could not primarily drive temperature. Furthermore, atmospheric CO₂ lags temperature at all measured time scales. <http://icecap.us/index.php/go/joes-blog/carbon-dioxide-in-not-the-primary-cause-of-global-warming-the-future-can-no/>

In my Figure 1 and 2, global dCO_2/dt is closely correlated with global Lower Tropospheric Temperature (LT) and Surface Temperature (ST). The temperature and CO₂ datasets are collected completely independently, and yet this close correlation exists.

After publishing this paper, I also demonstrated the same close correlation with different datasets, using Mauna Loa CO₂ data and Hadcrut3 ST back to 1958. Later I examined the close correlation of LT measurements taken by satellite and those taken by radiosonde.

Earlier papers by Kuo (1990) and Keeling (1995) discussed the delay of CO₂ after temperature, although neither appeared to notice the even closer correlation of dCO_2/dt with temperature. This correlation is noted in my Figures 3 and 4.

My hypothesis received a hostile reaction from both sides of the fractious global warming debate. All the "global warming alarmists" and most "climate skeptics" rejected it.

First I was just deemed wrong – the dCO_2/dt vs T relationship was allegedly a "spurious correlation".

Later it was agreed that I was correct, but the resulting ~9 month CO₂-after-T lag was dismissed as a "feedback effect". This remains the counter-argument of the global warming alarmists – apparently a faith-based rationalization to be consistent with their axiom "WE KNOW that CO₂ drives temperature".

This subject has generated spirited discussion among scientists. Few now doubt the close correlation dCO_2/dt vs T. Some say that humankind is not the primary cause of the current increase in atmospheric CO₂ - that it is largely natural. Others rely on the "mass balance argument" to refute this claim.

The natural seasonal amplitude in atmospheric CO₂ ranges up to ~16ppm in the far North (at Barrow Alaska) to ~1ppm at the South Pole, whereas the annual increase in atmospheric CO₂ is only ~2ppm. This seasonal "CO₂ sawtooth" is primarily driven by the Northern Hemisphere landmass, which has a much greater land area than the Southern Hemisphere. CO₂ falls during the Northern Hemisphere summer, due primarily to land-based photosynthesis, and rises in the late fall, winter and early spring as biomass decomposes.

Significant temperature-driven CO₂ solution and exsolution from the oceans also occurs.

See the beautiful animation at

http://svs.gsfc.nasa.gov/vis/a000000/a003500/a003562/carbonDioxideSequence2002_2008_at15fps.mp4

In this enormous CO₂ equation, the only signal that is apparent is that dCO_2/dt varies approximately contemporaneously with temperature, and CO₂ clearly lags temperature.

CO₂ also lags temperature by about 800 years in the ice core record, on a longer time scale.

I suggest with confidence that the future cannot cause the past.

I suggest that temperature drives CO₂ much more than CO₂ drives temperature. This does not preclude other drivers of CO₂ such as fossil fuel combustion, deforestation, etc.

My January 2008 hypothesis is gaining traction with the recent work of several researchers.

Here is Murry Salby's address to the Sydney Institute in 2011:

<http://www.youtube.com/watch?v=Yri03ts--9I&feature=youtu.be>

See also this January 2013 paper from Norwegian researchers:

The Phase Relation between Atmospheric Carbon Dioxide and Global Temperature

Global and Planetary Change, Volume 100, January 2013

by Humlum, Stordahl, and Solheim

<http://www.sciencedirect.com/science/article/pii/S0921818112001658>

- *Changes in global atmospheric CO₂ are lagging 11–12 months behind changes in global sea surface temperature.*
- *Changes in global atmospheric CO₂ are lagging 9.5–10 months behind changes in global air surface temperature.*
- *Changes in global atmospheric CO₂ are lagging about 9 months behind changes in global lower troposphere temperature.*
- *Changes in ocean temperatures explain a substantial part of the observed changes in atmospheric CO₂ since January 1980.*
- *Changes in atmospheric CO₂ are not tracking changes in human emissions.*

Observations and Conclusions:

1. Temperature, among other factors, drives atmospheric CO₂ much more than CO₂ drives temperature. The rate of change dCO_2/dt is closely correlated with temperature and thus atmospheric CO₂ LAGS temperature by ~9 months in the modern data record
2. CO₂ also lags temperature by ~800 years in the ice core record, on a longer time scale.
3. Atmospheric CO₂ lags temperature at all measured time scales.
4. CO₂ is the feedstock for carbon-based life on Earth, and Earth's atmosphere and oceans are clearly CO₂-deficient. CO₂ abatement and sequestration schemes are nonsense.
5. Based on the evidence, Earth's climate is insensitive to increased atmospheric CO₂ – there is no global warming crisis.
6. Recent global warming was natural and irregularly cyclical – the next climate phase following the ~20 year pause will probably be global cooling, starting by ~2020 or sooner.
7. Adaptation is clearly the best approach to deal with the moderate global warming and cooling experienced in recent centuries.
8. Cool and cold weather kills many more people than warm or hot weather, even in warm climates. There are about 100,000 Excess Winter Deaths every year in the USA and about 10,000 in Canada.
9. Green energy schemes have needlessly driven up energy costs, reduced electrical grid reliability and contributed to increased winter mortality, which especially targets the elderly and the poor.
10. Cheap, abundant, reliable energy is the lifeblood of modern society. When politicians fool with energy systems, real people suffer and die. That is the tragic legacy of false global warming alarmism.

Allan MacRae, Calgary, June 12, 2015

CARBON DIOXIDE IS NOT THE PRIMARY CAUSE OF GLOBAL WARMING: THE FUTURE CAN NOT CAUSE THE PAST

by Allan M.R. MacRae

The Intergovernmental Panel on Climate Change ("IPCC") stated in its 2007 AR4 report:

Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level.

... Carbon dioxide (CO₂) is the most important anthropogenic GHG. Its annual emissions grew by about 80% between 1970 and 2004.

... Most of the observed increase in globally-averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations. It is likely there has been significant anthropogenic warming over the past 50 years averaged over each continent (except Antarctica).

However, despite continuing increases in atmospheric CO₂, no significant global warming occurred in the last decade, as confirmed by both Surface Temperature and satellite measurements in the Lower Troposphere (Figures CO₂, ST and Figure 1).

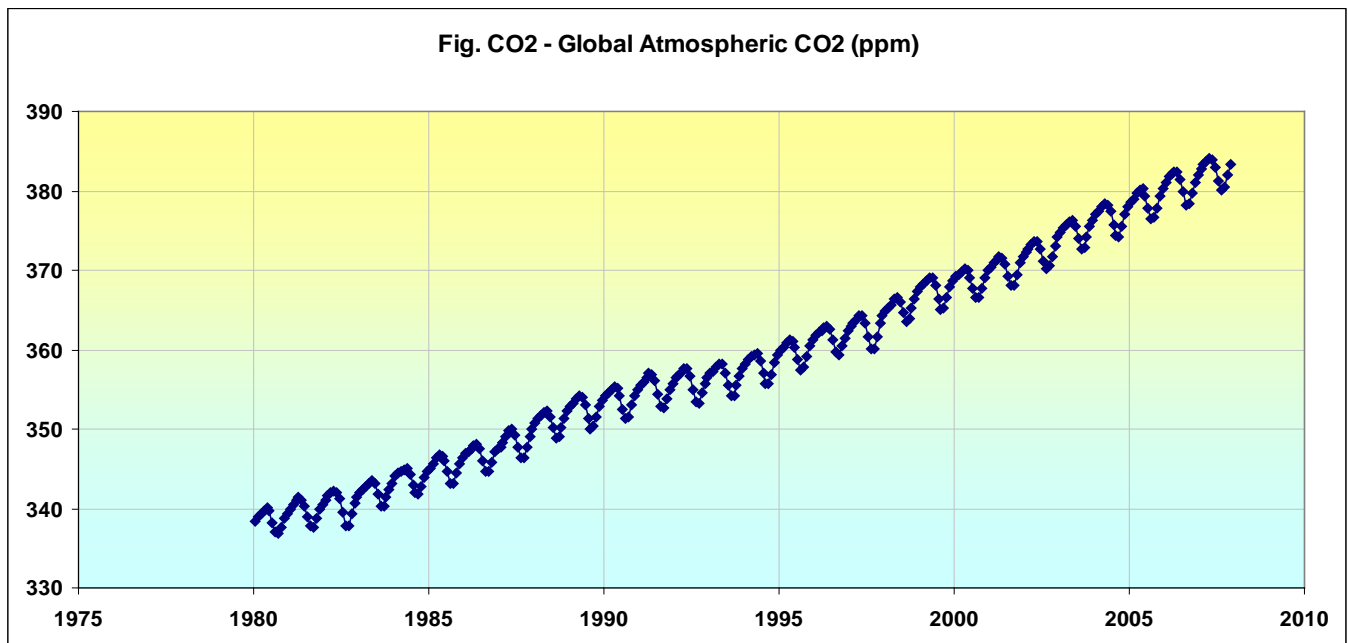


Fig. ST - Surface Temperature Anomaly HadCrut3 (degrees C)

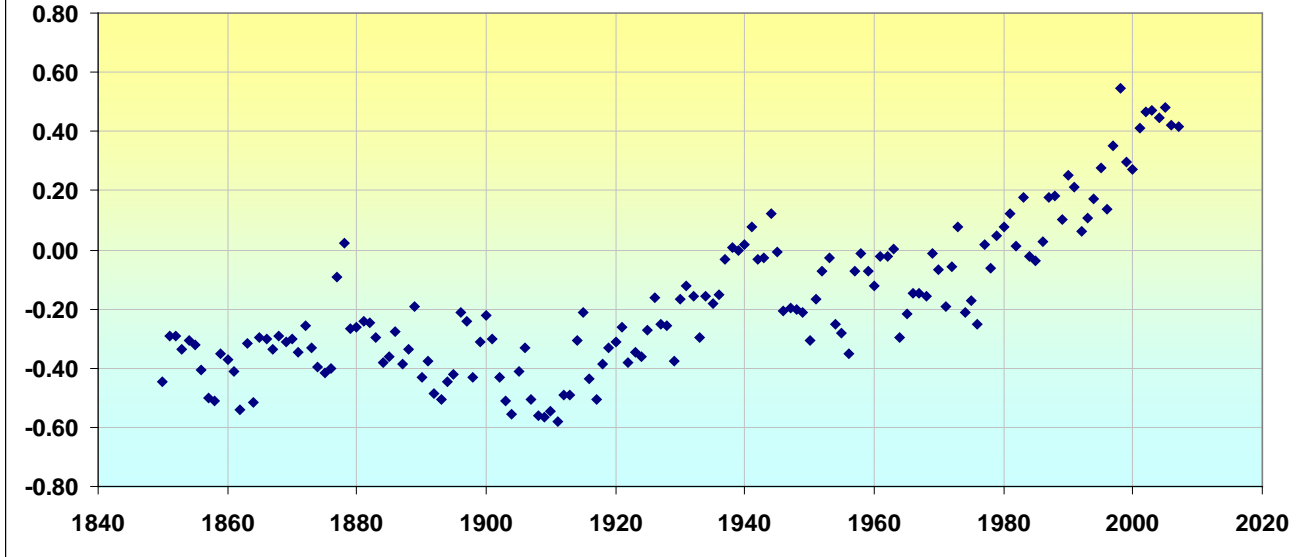
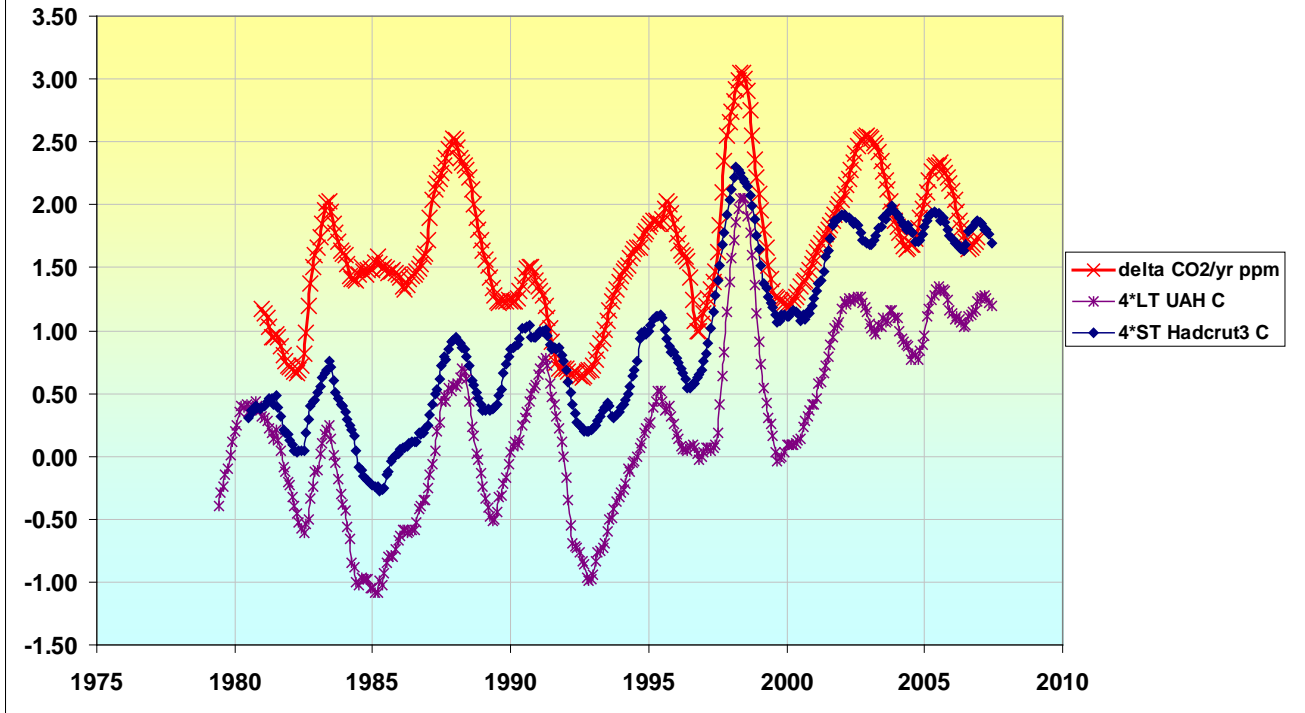


Fig. 1 - ST & LT temp & delta CO2/year vs. time, all Running Means, no deTrend



Contrary to IPCC fears of catastrophic anthropogenic global warming, Earth may now be entering another natural cooling trend.

Earth Surface Temperature warmed approximately ("~") 0.7 degrees Celsius ("C") from ~1910 to ~1945, cooled ~0.4 C from ~1945 to ~1975, warmed ~0.6 C from ~1975 to 1997, and has not warmed significantly from 1997 to 2007.

CO₂ emissions due to human activity rose gradually from the onset of the Industrial Revolution, reaching ~1 billion tonnes per year (expressed as carbon) by 1945, and then accelerated to ~9 billion tonnes per year by 2007. Since ~1945 when CO₂ emissions accelerated, Earth experienced ~22 years of warming, and ~40 years of either cooling or absence of warming.

The IPCC's position that increased CO₂ is the primary cause of global warming is not supported by the temperature data.

In fact, strong evidence exists that disproves the IPCC's scientific position. The attached Excel spreadsheet ("CO₂ vs T") shows that variations in atmospheric CO₂ concentration lag (occur after) variations in Earth's Surface Temperature by ~9 months (Figures 2, 3 and 4). The IPCC states that increasing atmospheric CO₂ is the primary cause of global warming - in effect, the IPCC states that the future is causing the past. The IPCC's core scientific conclusion is illogical and false.

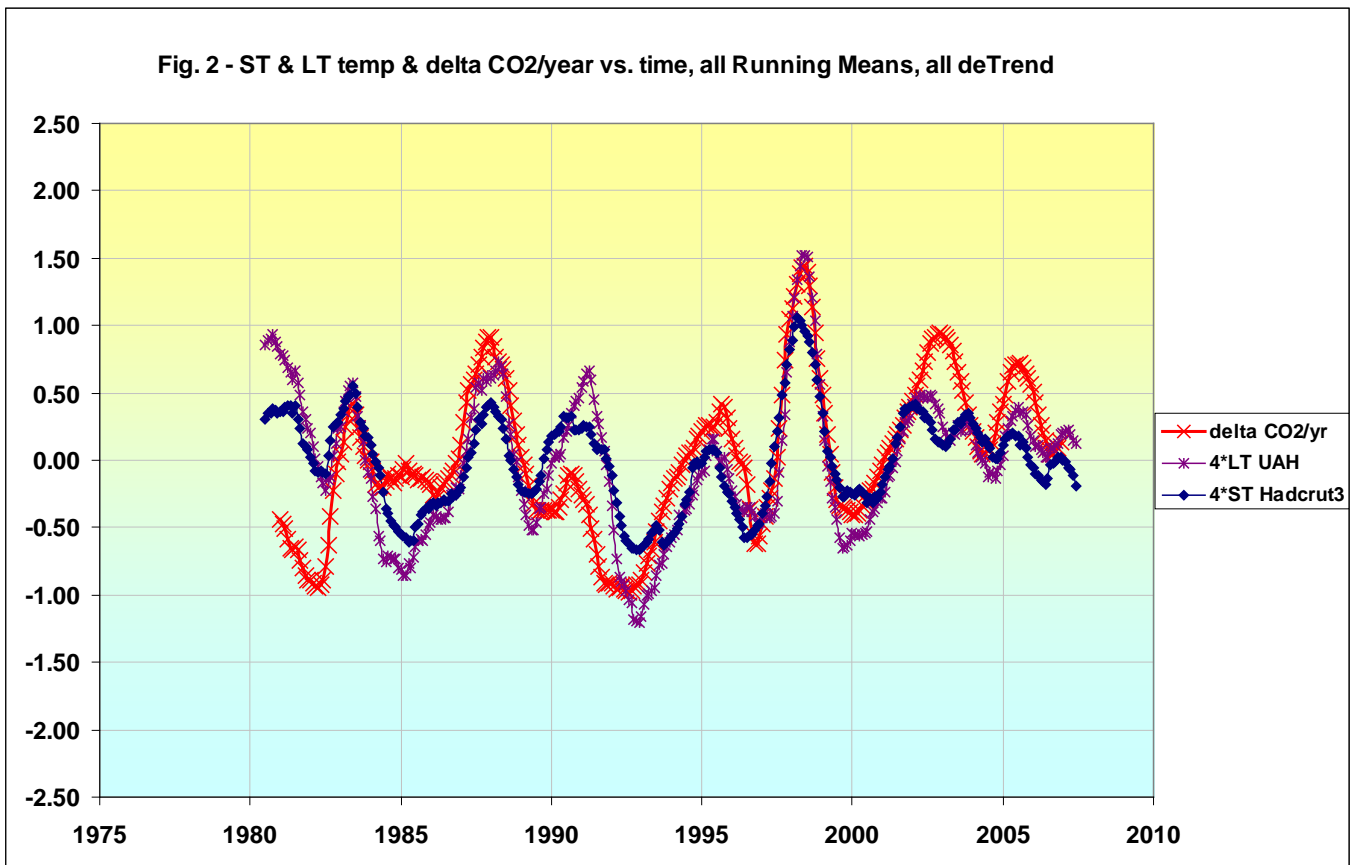


Fig. 3 - ST & LT temp, delta CO2/year & CO2 vs. time, all Running Means, all deTrend

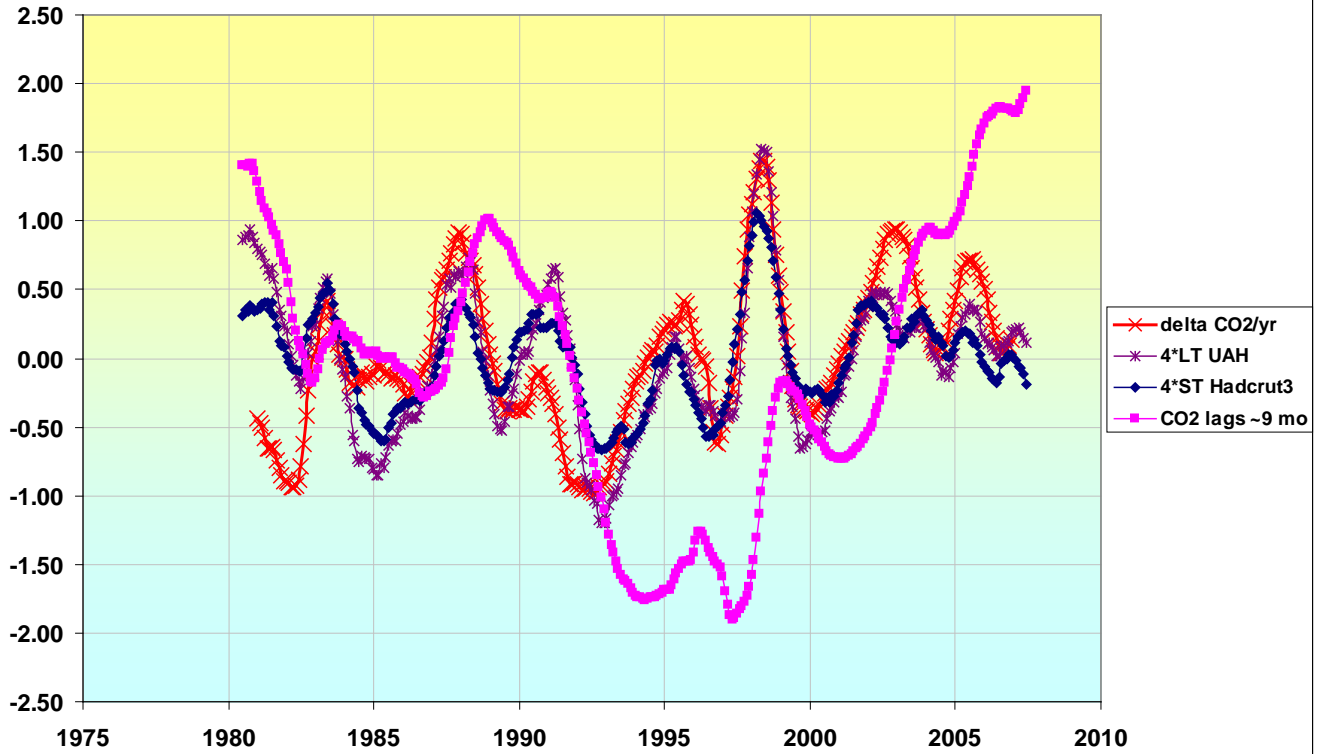
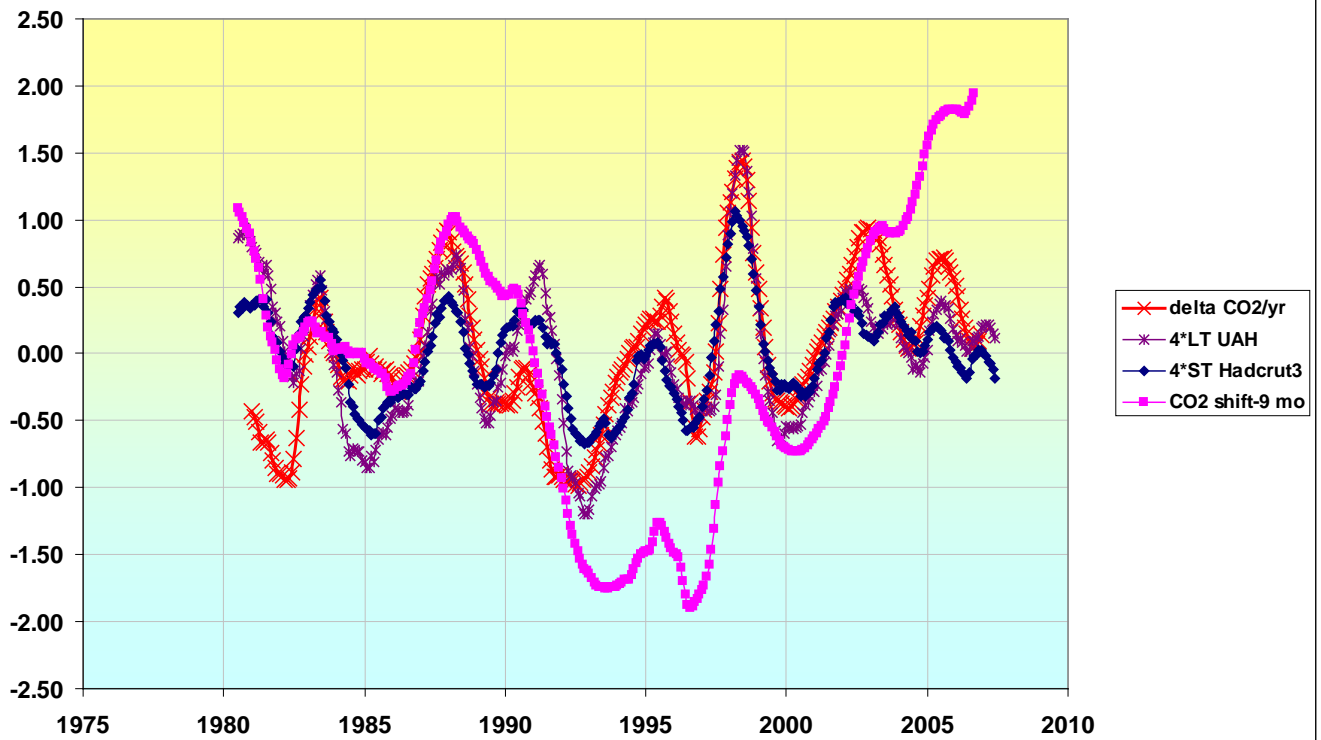


Fig. 4 - ST & LT temp, delta CO2/year & CO2 vs. time, all Running Means, all deTrend



There is strong correlation among three parameters: Surface Temperature ("ST"), Lower Troposphere Temperature ("LT") and the rate of change with time of atmospheric CO₂ ("dCO₂/dt") (Figures 1 and 2). For the time period of this analysis, variations in ST lead (occur before) variations in both LT and dCO₂/dt, by ~1 month. The integral of dCO₂/dt is the atmospheric concentration of CO₂ ("CO₂") (Figures 3 and 4).

Natural seasonal variations in temperatures ST and LT and atmospheric CO₂ concentrations all considerably exceed average annual variations in these parameters. For this reason, 12 month running means have been utilized in Figures 1 to 4. All four parameters ST, LT, dCO₂/dt and CO₂ are global averages. ST and LT have been multiplied times 4 in Figures 1 to 4 for visual clarity.

Figure 1 displays the data before detrending, and shows the strong correlation among ST, LT and dCO₂/dt. Detrending removes the average slope of the data to enable more consistent correlations, as in Figures 2 to 4. In Figure 3, the atmospheric CO₂ curve is plotted with the three existing parameters, and lags these three by ~9 months. This lag is clearly visible in Figure 4, with the CO₂ curve shifted to the left, 9 months backward in time.

Figures 5 to 8 (included in the spreadsheet) do not use 12 month running means, and exhibit similar results.

The period from ~1980 to 2007 was chosen for this analysis because global data for LT and CO₂ are not available prior to ~1980. This period from ~1980 to 2007 is also particularly relevant, since this is the time when most of the alleged dangerous human-made global warming has occurred.

In a separate analysis of the cooler period from 1958 to 1980, global ST and Mauna Loa CO₂ data were used, and the aforementioned ~9 month lag of CO₂ behind ST appeared to decline by a few months.

The four parameters ST, LT, dCO₂/dt and CO₂ all have a common primary driver, and that driver is not humankind.

Veizer (2005) describes an alternative mechanism (see Figure 1 from Ferguson and Veizer, 2007, included herein). Veizer states that Earth's climate is primarily caused by natural forces. The Sun (with cosmic rays – ref. Svensmark et al) primarily drives Earth's water cycle, climate, biosphere and atmospheric CO₂.

Veizer's approach is credible and consistent with the data. The IPCC's core scientific position is disproved - CO₂ lags temperature by ~9 months - the future can not cause the past.

While further research is warranted, it is appropriate to cease all CO₂ abatement programs that are not cost-effective, and focus efforts on sensible energy efficiency, clean water and the abatement of real atmospheric pollution, including airborne NO_x, SO_x and particulate emissions.

The tens of trillions of dollars contemplated for CO₂ abatement should, given the balance of evidence, be saved or re-allocated to truly important global priorities.

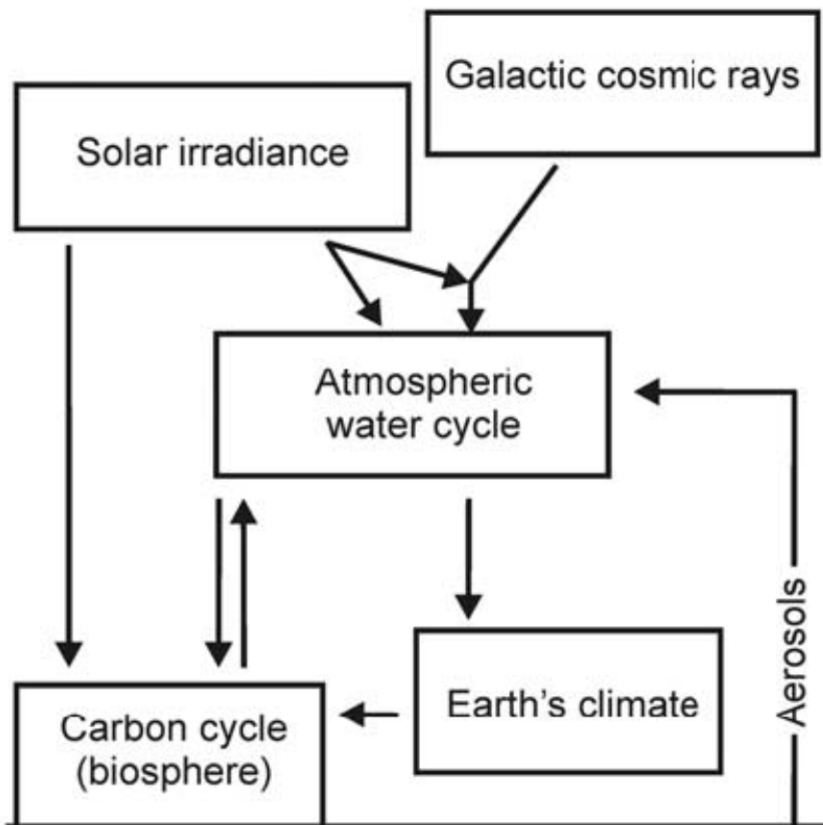
Excerpts from Veizer (GAC 2005):

Pages 14-15: The postulated causation sequence is therefore: brighter sun => enhanced thermal flux + solar wind => muted CRF => less low-level clouds => lower albedo => warmer climate.

Pages 21-22: The hydrologic cycle, in turn, provides us with our climate, including its temperature component. On land, sunlight, temperature, and concomitant availability of water are the dominant controls of biological activity and thus of the rate of photosynthesis and respiration. In the oceans, the rise in temperature results in release of CO₂ into air. These two processes together increase the flux of CO₂ into the atmosphere. If only short time scales are considered, such a sequence of events would be essentially opposite to that of the IPCC scenario, which drives the models from the bottom up, by assuming that CO₂ is the principal climate driver and that variations in celestial input are of subordinate or negligible impact....

... The atmosphere today contains ~ 730 PgC (1 PgC = 1015 g of carbon) as CO₂ (Fig. 19). Gross primary productivity (GPP) on land, and the complementary respiration flux of opposite sign, each account annually for ~ 120 Pg. The air/sea exchange flux, in part biologically mediated, accounts for an additional ~90 Pg per year. Biological processes are therefore clearly the most important controls of atmospheric CO₂ levels, with an equivalent of the entire atmospheric CO₂ budget absorbed and released by the biosphere every few years. The terrestrial biosphere thus appears to have been the dominant interactive reservoir, at least on the annual to decadal time scales, with oceans likely taking over on centennial to millennial time scales.

Excerpt from Ferguson & Veizer (JGR 2007):



Ferguson & Veizer Figure 1
A schematic diagram of the principal drivers of the Earth's climate system. The connections between the various components are proposed as a hypothesis for coupling the terrestrial water and carbon cycles via the biosphere. Galactic cosmic rays and aerosols are included, although their roles are more contentious than other aspects of the Earth's climate system.

References and Acknowledgements:

IPCC Fourth Assessment Report, Climate Change 2007, Synthesis Report
http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf

Svensmark et al, Center for Sun-Climate Research, Danish National Space Center, Copenhagen
www.spacecenter.dk/research/sun-climate

Veizer, "Celestial Climate Driver: A Perspective from Four Billion Years of the Carbon Cycle", GeoScience Canada, Volume 32, Number 1, March 2005
<http://www.gac.ca/publications/geoscience/TOC/GACgcV32No1Web.pdf>

Ferguson & Veizer, "Coupling of water and carbon fluxes via the terrestrial biosphere and its significance to the Earth's climate system", Journal of Geophysical Research - Atmospheres, Volume 112, 2007
<http://www.agu.org/pubs/crossref/2007/2007JD008431.shtml>

Spencer, Braswell, Christy & Hnilo, "Cloud and radiation budget changes associated with tropical intraseasonal oscillations", Geophysical Research Letters, Volume 34, August 2007
<http://www.agu.org/pubs/crossref/2007/2007GL029698.shtml>

McKittrick & Michaels, "Quantifying the influence of anthropogenic surface processes and inhomogeneities on gridded global climate data", Journal of Geophysical Research - Atmospheres, Volume 112, December 2007
<http://www.agu.org/pubs/crossref/2007/2007JD008465.shtml>

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Conclusions, errors and omissions are the sole responsibility of the writer.

Data sources are gratefully acknowledged:

Surface Temperatures: Climatic Research Unit, University of East Anglia, Norwich, UK
<http://www.cru.uea.ac.uk/>

Lower Troposphere Temperatures: The National Space Science and Technology Center, University of Alabama, Huntsville, USA
<http://www.atmos.uah.edu/>

Atmospheric CO₂ concentrations: NOAA Earth System Research Laboratory, Global Monitoring Division, Boulder CO, USA
<http://www.esrl.noaa.gov/gmd/ccgg/trends/>

CO₂ emissions (expressed as carbon): Marland, Boden & Andres, 2007, "Global, Regional, and National CO₂ Emissions", in "Trends: A Compendium of Data on Global Change", Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A
http://cdiac.ornl.gov/ftp/ndp030/global.1751_2004.ems

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