

# Carbon Dioxide (CO<sub>2</sub>) and Climate Change

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## ABSTRACT

Created in the Earth's atmosphere, dissolved in seas and oceans, combined in carbonates and other crustal rocks (sinks), carbon dioxide (CO<sub>2</sub>) is the essence for sustaining life on Earth. This paper looks at the origins and interactions of CO<sub>2</sub> gases with the atmosphere. The question is does carbon dioxide cause climate change as understood by climate scientists or do global environmental changes occur because of other causes (known/unknown) or because of a combination of many factors, a few, or primarily CO<sub>2</sub>? This analysis examines the origins, scientific interaction, and contentious claims relating to CO<sub>2</sub> in the atmosphere. The conclusion arrived at is that CO<sub>2</sub> (a heat absorbing trace gas with a short residency time of negligible atmospheric volume (in ppmv), otherwise known as a Greenhouse Gas (GHG) that constitutes a Greenhouse Effect (GE), is insufficient to account for high degrees of warming to effect climate changes on our planet,

## CO<sub>2</sub> ANALYSIS

An atypical source of CO<sub>2</sub> can accumulate in the Earth's atmosphere that originates from high energy cosmic rays generated in deep space (galactic and intergalactic) - and to a lesser degree variable radiation from the sun. Cosmic rays enter the Earth's atmosphere and collide with atmospheric atoms thereby activating energetic neutrons. In turn these neutrons collide with nitrogen atoms converting them to carbon: [<sup>1</sup>n + <sup>14</sup>N → <sup>14</sup>C + <sup>1</sup>H] <sup>(1)</sup>. Carbon14 (<sup>14</sup>C) is a radioisotope widely used for dating purposes (chemical symbols expressed as C<sup>14</sup>/C<sup>12</sup>/N<sup>14</sup> etc for convenience purposes). Organisms ingest Carbon14 and expel it as a gas (CO<sub>2</sub> - a respiratory chemical process), and when they die the carbon element retained converts to carbon12 (C<sup>12</sup>). Over-time this radioisotope reverts back to its original form as nitrogen14 (N<sup>14</sup>) via the beta decay (β+) process.

The atmospheric content of C<sup>14</sup> makes up ~1ppt (part per thousand) of carbon in the atmosphere at the present time <sup>(2)</sup>, but with a continuum of cosmic radiation C<sup>14</sup> is likely to increase (or vice versa). Similarly, like carbon12, Carbon14 is absorbed as a dissolved gas with free oxygen [O → <sup>14</sup>C = CO<sub>2</sub>] which then produces oxygen2 (O<sub>2</sub>) as a process of photosynthesis. The significance is that carbon14 can be created in the atmosphere as a result of increasing cosmic radiation. But this can change depending upon the sun's variable insolation, which in highly active conditions (sunspots) reduces the amount of cosmic radiation and hence the manufacture of C<sup>14</sup> - more sunspots produce more surface heat which in turn, by a process of a phase transition, drives CO<sub>2</sub> out of natural sinks: (O + <sup>14</sup>C/<sup>12</sup>C → CO<sub>2</sub>) into the atmosphere. These changes enhance surface environments, particularly at polar latitudes where solar irradiance is variable, and during prolonged ice age conditions brings about periods of warming known as 'interstadials'.

Significantly cosmic radiation impinges on the Earth's atmosphere in other ways too. Whereas evaporation and condensation was once thought to be at the root of cloud production, additional cloud development in the low troposphere (<~3000m) is formed as a result of high-energy cosmic ray bombardments called muons <sup>(3)</sup>. As electrons are set free in the atmosphere cloud condensation nuclei form and water vapour condenses to cloud. It is well known that nano-particulates of sulphurous dust (volcanism etc) in the atmosphere become the seeds for water molecules to form clouds in the usual way. However a space-rush of muons can become trapped in the tropopause to bring about periodic cooling, particularly when the Sun's irradiance is energy deficient (too weak) and inadequately warms surface air temperatures. Atmospheric cooling is further encouraged as solar radiation is diverted back into space, a so-called feedback known as the albedo effect. During inactive sun phases (no sunspots) low-level cloud is formed and begins to dominate the Earth's lower atmosphere. As a result climate zones become colder and more quiescent. Organic development in the biosphere is also affected in a negative way (low growth & extinctions) and a radical change in surface conditions is again likely to bring about the onset of glaciation. Such changes encourage the development of full ice age conditions.

Another source of CO<sub>2</sub> is elemental where it is stored in the Earth's natural sinks and reservoirs. This source is thought to relate to so-called 'anthropogenic climate change' (human induced from the utilisation of energy from industry) about which it is also said causes reactions between carbon isotopes (the carbon cycle) as they combine with oxygen to form carbon dioxide. This process purports to create unacceptable atmospheric warming conditions induced by solar heat reacting with radiant gases (H<sub>2</sub>O, CO<sub>2</sub>, CH<sub>4</sub>, etc) - these reactant gases absorb and retain degrees of heat in the thermal infrared (IR) wavelength, resulting in a so-called GE. Uniquely the main gas singled-out that causes this effect is carbon dioxide (CO<sub>2</sub>). A trace gas (388ppmv) which resides in the atmosphere and said to originate almost exclusively from anthropogenic industrialisation sources (recycled carbon) and the burning of fossil fuels. By definition therefore this gas attains a position of achieving a fixed 'Atmospheric Energy Balance' - notwithstanding that the largest amounts of carbon dioxide are stored naturally in the Earth's sinks such as large water bodies (seas and oceans) and in the Earth's crust and mantle <sup>(4) (5)</sup>. In times of high solar irradiance (an active sun) increased surface warming releases carbon dioxide from natural sinks to the atmosphere - the process is slow lagging behind increasing warming by several hundred to a thousand years - significantly to achieve today's values. However trace amounts of carbon dioxide are retained (with a relatively short residency time (~4 → 200 years?) in the troposphere (a low-level surface mixing zone) until reabsorbed again by natural sinks during times of cyclical cooling.

## DISCUSSION

The science controversy about GHGs has always been about molecular atmospheric CO<sub>2</sub> dating from the 1800s (Fourier & Arrhenius) to the 1950s (Callender)<sup>(5)</sup>. It quietly gathered pace again in the 1980s until the present time when it became a hot political issue following widespread publicity from activist groups – more recently the GHG methane (CH<sub>4</sub>, volume = 1700ppb) has been singled for special attention because it too is said to generate a (higher) irradiative response than CO<sub>2</sub>.

Carbon dioxide is thought by some to be a pollutant gas because it engenders overwhelming warming conditions (some say catastrophic) and therefore thought to be unusually dominant in the low troposphere (our life-supporting milieu) with a very long residency time. As a result this gas is said to be the sole contributor to (unacceptable) anthropogenic global warming (AGW), re-titled in recent times to global climate change (CC). CC is also considered to influence all prevailing weather patterns resulting in increasing dynamic meteorological events worldwide. However water vapour (H<sub>2</sub>O) is certainly the most dominant irradiative gas in our atmosphere and the principle energy source in all weather systems. Significantly water vapour accounts for ~ 4% of the Earth's total atmospheric budget and is by far the principal GHG, yet rarely (never) referred to in climate modelling feedbacks, texts or diagrams - dilution of water vapour (by volume) compared with the other reactive gases is without doubt the most substantial where weather and climate fluctuations are concerned.

With regard to CO<sub>2</sub> and its forcing effect on climate warming (subscribed to by the AGW orthodoxy) it is never challenged, nor made aware, that atmospheric gases, especially carbon dioxide, is measured using a logarithmic scale. CO<sub>2</sub> does not absorb infra-red radiation over a linear range as many scientists mistakenly believe. Because CO<sub>2</sub> is strongly logarithmic in scale (a measurement that displays the value of a physical quantity using intervals corresponding to orders of magnitude), the first 1.5°C of molecular CO<sub>2</sub> arises from the initial 20ppm. The next 1.5°C increase requires a further 400ppm, and then 1°C for a further 1000ppm. The significance of this is that with current levels put at 0.038% a 100ppm increase will amount to ~0.1°C warming after 50 years and less so with each added 100ppm increment. Or put another way, assuming a rising rate of 2ppm per annum (IPCC), temperatures will rise at 0.1°C for every 50 years<sup>(10)</sup>. Furthermore CO<sub>2</sub> forcing can only be radiated over a tiny portion of the infra-red (IR) spectrum which is within a 15 micron bandwidth. Gaseous H<sub>2</sub>O on the other hand (~4% of all atmospheric gases) is measured similarly but over almost the entire bandwidth.

Wherever anthropogenic CO<sub>2</sub> intervention is documented today, it is said that warming trends will continue indefinitely due to continuing industrial activities (IPCC – CO<sub>2</sub> concentrations 1840-1995-2100; 0.0353ppm to 0.0500ppm by the year 2040 – see 2006 website). In a paper dated October 1955 scientists put levels at anything from 0.0330 to 0.0440ppm<sup>(5)</sup> indicating negative increases. So it seems little has changed from the research carried out over 50 years ago where CO<sub>2</sub> atmospheric variation were even then becoming a hot topic among meteorologist and atmospheric physicists. Vast amounts of data was tested from a wide variety of locations using similar techniques to those of today (wet and dry method analyzers) - interestingly scientists who support anthropogenic cause and effect stem mainly from meteorology and associated disciplines and very few come from geo-science backgrounds who are well aware of geological climate fluctuations through vast periods of time.

A wealth of insight and knowledge about climate science has been ignored by the media, politicians and AGW scientists, even though vast amounts of research by Earth scientists, astrophysicists, cosmologists, climatologists and other disciplines is today available from easily accessed websites and institutions. Much information is still being researched but what is available has been made accessible on the world-wide-web with attempts to address all known (and unknown) variables relating to climate science. For example a well informed paper of climate modelling/residency times and AGW CO<sub>2</sub> on the construction of GE global warming is available (Segalstad 1997) together with unbiased independent studies, such as (<http://brneurosci.org/co2.html>) which are highly informative. Such (more rounded) unprejudiced studies from many Earth and climate scientists foretell of variable factors (too many to discuss here) that point to warming and cooling periods over shorter time spans than was previously envisaged in addition to episodically longer periods deduced from the geological record.

Further studies (all readily accessible) include the influence of Heinrich Events (sedimentary marine core data), D-O Cycles (ice core data), and Milankovic Cycles (Solar system planetary cycles. Solar insolation alone amounts to 99% of warming and radiative forcing at the Earth's surface, where a warming phase transition releases CO<sub>2</sub> to the atmosphere in relatively short-term (hundreds of years) reversible time frames<sup>2</sup>. Simple experiments demonstrate that solar irradiance cycles contribute miniscule amounts of carbon dioxide to the atmosphere – in short insolation is the driving mechanism of all atmospheric heating ('The Blanket Effect') and not trace amounts of CO<sub>2</sub> gases. Known climate change variables are listed in a pyramidal diagram (Fig 1) which attempts to demonstrate that the focus for AGW cause and effect, based almost entirely on a correlation that GHGs retain heat and are therefore heating the atmosphere, fails to persuade many scientists (the sceptics) that CO<sub>2</sub> (a minor thermally reactive gas) is the prime source for global warming or climate change.

By these criteria alone, it is clear climate science has become sloppy ('Climategate!') and which must become more rigorous in its research methods, and the debate (such as it is), more inclusive to sceptical opinion and research than hitherto. That is to say the science should not be judgemental of itself, and can only improve from evidence-based (empirical) studies, preferably subjected to wider scrutiny and peer-review.

## COMMENT

Regardless of so-called malign influences attached to CO<sub>2</sub>, regarded as a pollutant by some and which increases global warming by others, there is a need to address other factors including, for example, the disciplines associated with atmospheric physics if we are to attain a semblance of scientific integrity with the media. Certainly few would argue that solar radiation obtains warming of the troposphere via longwave (back) radiation. Most climate scientists seem to suggest that this warming via CO<sub>2</sub> input has (and is) over-time increasing heating of the atmosphere.

Clearly there is a conflict here because it affronts the Second Law of Thermodynamics as no such phenomenon has ever been measured, and in reality it cannot exist. Increased warming of this kind may have been misunderstood for the so-called 'Blanket Effect' which is in fact a cooling mechanism that releases heat from the atmosphere as it does with all (terrestrial) planetary systems<sup>(11)</sup>. Ever increasing warming in our atmosphere (because of GHGs), is a contradiction in terms. Such (diurnal) heat is permeated to the expanse of space at the top of our atmosphere and does not (cannot) increase warming. The 2<sup>nd</sup> law states; Entropy of a closed system always increases and in heat transfer situations, heat energy is transferred from higher temperature components to lower temperature components.

Nitrogen and oxygen (N<sub>2</sub>/O<sub>2</sub> – 78.09% & 20.95% respectively) overwhelmingly constitute the mass of our atmosphere) and such gases are considered to be non-irradiative within the GE paradigm. It is logical to suppose therefore, that because of their molecular abundance they trap solar energy (longwaves) while some heat is absorbed by reactive GHGs - hence this method provides for our blanket effect'. Ergo, if GHGs thermally radiate energy and the major constituent gases do not, then GHGs must cool the planetary surface because they provide the (only) means to shed heat in accordance with the 2<sup>nd</sup> Law. And because the prime agency of heat to the Earth's atmosphere is via insolation (solar radiation renewed and dissipated cyclically every 24 hours), then it must be that all non-GHGs (N<sub>2</sub>/O<sub>2</sub>) contribute extensively to the GE since secondary GHGs (the minor gases) dispense energy in no other way.

Therefore AGW GHGs returned to the atmosphere from the 'burning of fossil fuels' is highly unlikely (scientifically impossible) to bring about global warming from tiny quantities of CO<sub>2</sub> expressed in terms of parts per million by volume (ppmv). It may well be that climate change is occurring (it always has, the atmosphere is never in stasis), but placed in perspective, carbon dioxide' along with ALL gases actually cools the atmosphere and moreover is fundamental to the existence of life on Earth. Yet unambiguously predetermined (on the scantiest of evidence – a correlation!) that it is solely responsible for global climate change. – the ratio of CO<sub>2</sub> molecules is so small as to be effectively lost in the 'noise' of our complex atmospheric system<sup>(10)</sup> and because of unknown inputs and outputs.

As for radical solutions to decarbonise our atmosphere (ubiquitously said to 'save the planet') utilising (unproven and expensive) geo-engineering sequestration (burial) methods, is seemingly fraught with difficulties (notwithstanding the costs and lack of technical know-how) and which likely will discharge more unintended AGW GHGs to the atmosphere in running and maintenance costs alone. The adaptability to potentially changing climatic conditions offers more in the way of solutions than untested decarbonisation projects. Moreover there already exists natural reservoirs that decarbonise our atmosphere rather well - namely the biosphere comprising the sum total of all global ecosystems. These are the living organisms (flora & Fauna), the world's oceans and the lithosphere itself (the rock cycle). Together these natural sinks provide for an interactive self-regulating ocean/atmosphere system routinely fine-tuned to (gradual) changes influenced by solar and planetary activities.

Global carbon dioxide fluctuations (up or down) amount to no more than miniscule effects in the composition of our atmosphere measured in parts per million by volume (ppmv). Currently this purports to stand at 390 ppmv (1/27<sup>th</sup>% whole atmosphere) which has risen from 360ppmv from 1996 to the present time (2012 – IPCC) - a 16 year period in which time there has been no discernible increase in global warming (CRU, UEA 2012). In this time CO<sub>2</sub> emission are said to have risen proportionally up to 30ppmv. Notwithstanding this new data of AGW GHGs represent less than 10ppmv of this increase. Unhelpfully the IPCC and supporters tend to express CO<sub>2</sub> emissions in quantities of millions or billions of tons. For example the [Worldwatch Institute](#) reports that carbon emissions worldwide have increased from about 1 billion tons in 1900 to about 7 billion tons in 1995. The Institute also notes that the average surface temperature of the Earth has gone from 14.5 degrees C in 1860 to 15.3 degrees C in 1980. The evidence for these inputs is not given (rather vague - proxy records?) and therefore perhaps too precise to be reliable.

Nonetheless, the concept of expressing data in billions of (imperial) tons (metric!) paints an alarming picture of how human kind is wanton and systematically destroying the planet – not very helpful from a scientific point of view when the 9 billions ton (increase) is an insignificant sum compared to the volume, breadth and mass of Earth’s atmosphere, but clearly sufficient to create the notion of human culpability. Stephen Hawking put it succinctly thus *‘The human capacity for guilt is such that people can always find ways to blame themselves’* <sup>12</sup>.

## CONCLUSIONS

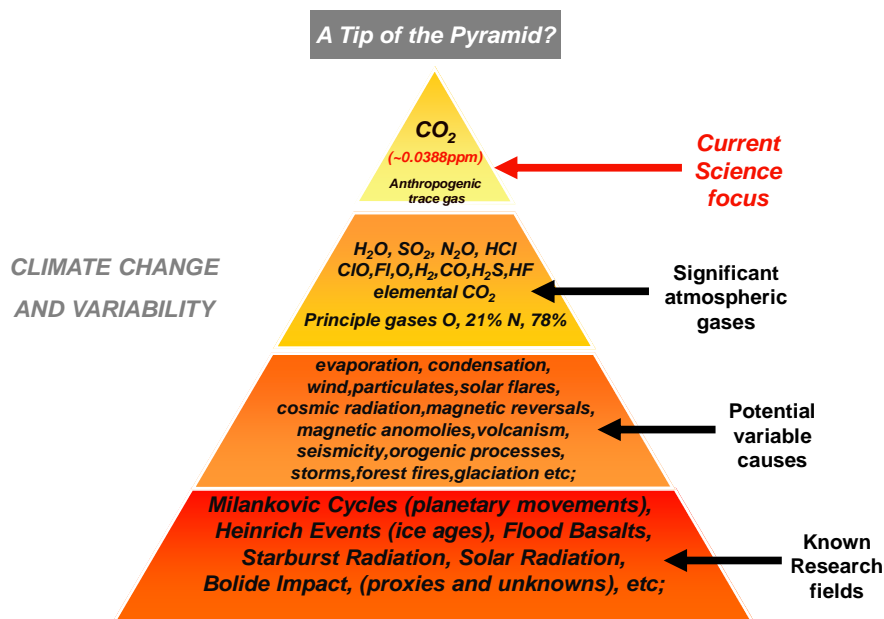
It was said of some scientists, none of whom were climate scientists, who favoured anthropogenic cause and effect during the 1930s to 1950s, following Arrhenius’s closed system (laboratory) experiments, and of which it could still be said; *‘.....interesting extrapolations.....stimulates the interests of the speculatively minded’* <sup>(5)</sup>. And that current practitioners who favour the AGW hypothesis constitute what can only be coined ‘museum science’ (arcane) because it does not observe the modern scientific method of researching alternative initiatives.

Sadly we are where we are today because the main public broadcast media with aid from the ‘noble causes’ green lobby have failed (or have no interest) in understanding the minutiae of our climate system. As a result the political establishment (now feel) they may ensure their re-election futures by surrendering to the ever increasing antics of lobby groups. The get-out clause of government ministers seems to be to adhere to a so-called ‘precautionary principle’ a belief system that supposes science research must be proven. This ‘better safe than sorry’ (unscientific) noble cause policy places restraints on scientific progress in that everything must be 100% safe before proceeding to the next stage. Such a policy of course rules out everything and anything, from say, stem cell research to studies of how GM crops mutate, not forgetting the debacle of the MMR fiasco – preservation of the *status quo* inexorably stifles any form of progress.

Finally the illustration presented below (Fig 1) is analogous of known climate complexities and attempts to show the tip of a pyramid representing CO<sub>2</sub> as disproportionate in our atmosphere compared with other reactive and non-reactive gases and the potential for longer term causes. Dilution of GHGs in the atmosphere is greater than 10<sup>60</sup>, or one followed by sixty zeros measured to its supposed upper limit of 10,000m = 17.25 billion cubic meters – as for the mass of CO<sub>2</sub> this is lost as an entity given that it represents a fraction of one percent of the atmosphere to which anthropogenic input is practically negligible as to be a major factor.

The asymmetry of the pyramidal diagram, while not scientific of itself, displays more lopsidedness when inverted – hardly a stable base of scientific certainty. Above all, when the so-called scientific ‘Consensus’ and lobbyists flood the media and broadcast airwaves at every opportunity (*ad nauseam*), with the propagandist mantra that ‘The science is settled’. Well as the ‘Contra-consensus’ reminds us that; **‘if it is settled, then it’s not science, and if it is science then it’s not settled’**.

**Fig 1**



*Science focus of anthropogenic CO<sub>2</sub> against known reactive gases, potential causes and climatic variables*

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