

# Role of atmospheric carbon dioxide in climate change

Martin Hertzberg and Hans Schreuder

## Abstract

The authors evaluate the United Nations Intergovernmental Panel on Climate Change (IPCC) consensus that the increase of carbon dioxide in the Earth's atmosphere is of anthropogenic origin and is causing dangerous global warming, climate change and climate disruption. The totality of the data available on which that theory is based is evaluated. The data include: (a) Vostok ice-core measurements; (b) accumulation of CO<sub>2</sub> in the atmosphere; (c) studies of temperature changes that precede CO<sub>2</sub> changes; (d) global temperature trends; (e) current ratio of carbon isotopes in the atmosphere; (f) satellite data for the geographic distribution of atmospheric CO<sub>2</sub>; (g) effect of solar activity on cosmic rays and cloud cover. Nothing in the data supports the supposition that atmospheric CO<sub>2</sub> is a driver of weather or climate, or that human emissions control atmospheric CO<sub>2</sub>.

## Keywords

IPCC paradigm, atmospheric CO<sub>2</sub>, human emission, atmospheric temperatures, ice core data, satellite data

## Introduction

Over the last 200 years, data show that there has been a more or less steady increase in the average atmospheric concentration of carbon dioxide (CO<sub>2</sub>), from 280 ppmv (parts per million by volume) to 400 ppmv. That is a 43% increase, from 0.028% to 0.040%. CO<sub>2</sub> is said to be a 'greenhouse gas,' which traps heat or prevents infrared radiation from being lost to free space.

It is argued that the increase of CO<sub>2</sub> is caused by the human combustion of fossil fuels such as coal, petroleum products and natural gas, and that any continuing increase is a threat to the earth's habitability. According to the United Nations Intergovernmental Panel on Climate Change (IPCC) paradigm, increases in atmospheric CO<sub>2</sub> precede and cause parallel increases in the Earth's temperature.

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A large number of the world Governments, professional societies, editors of scientific journals, print journalists, TV media reporters and many corporations generally accept the validity of the IPCC paradigm. Accordingly, there is a concerted effort to reduce CO<sub>2</sub> emissions, tax such emissions and replace fossil fuel combustion by alternative energy sources.

The purpose of this report is to summarise all available observations and measurements relating to the IPCC paradigm and question all aspects of the anthropogenic global warming (AGW)/ catastrophic anthropogenic climate change (CACG) hypothesis.

## The ice-core data

Our common experience with extreme events such as hurricanes, typhoons, blizzards, tsunamis, droughts, floods, heat waves, cold waves, tornadoes, earthquakes or volcanic eruptions, leads to the conclusion that weather, climate and geology are controlled by natural forces on a scale that dwarfs human activity and ability to influence them.

One example of such extremes is found in the ice-core data obtained from drilling into glaciers in Greenland or Antarctica. The ice-core data from the Vostok station in Antarctica are shown in Figure 1.

The red line shows the inferred atmospheric CO<sub>2</sub> concentrations from bubbles trapped in the ice and the blue line the atmospheric temperature relative to recent value as inferred from oxygen isotopic ratios.<sup>1</sup> The data span the last 420,000 years and reveal four glacial cooling eras whose average temperatures are some 8°C to 9°C below current values. The data show some five interglacial warming eras with temperatures 1–3°C warmer than current values.

The average time span between peak cooling (or maximum warming) eras is some 100,000 years and would appear to correlate with the periodic changes in the eccentricity of the Earth's elliptical orbit about the sun.

The Vostok data also show a correlation between long-term variations in temperature and variations in CO<sub>2</sub>. At the extreme of a glacial cooling era, CO<sub>2</sub> values are around 125 ppmv. At the peak of the ensuing glacial warming era, CO<sub>2</sub> is around 290 ppmv. It is acknowledged that many changes can occur to CO<sub>2</sub> molecules trapped in bubbles in ice for many centuries,

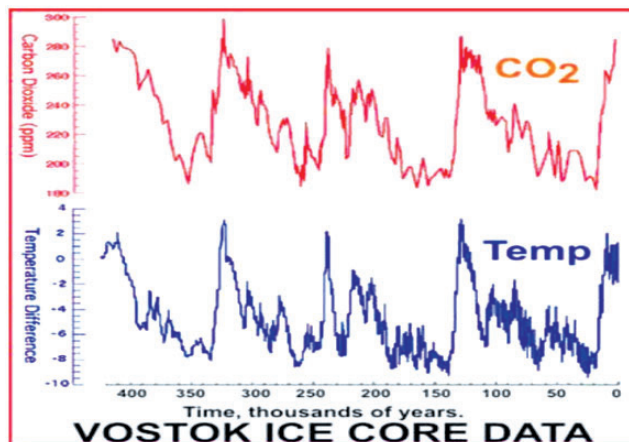


Figure 1. Vostok ice-core data.<sup>1</sup>

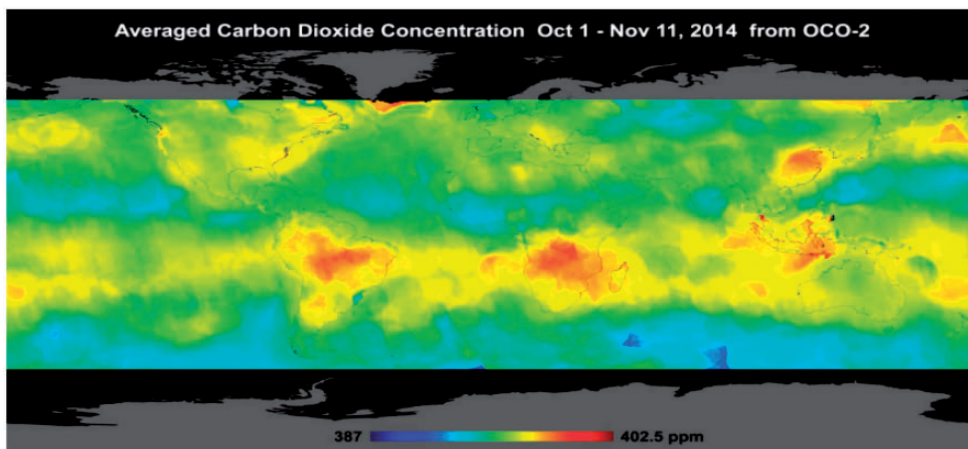
so the absolute values measured in the ice cores should not be taken at face value.<sup>2</sup> However, their relative values are probably accurate enough. They reflect more than a doubling of CO<sub>2</sub> between a cooling era minimum and a warming era maximum.

The IPCC uses the observed correlation between CO<sub>2</sub> and temperature in Vostok data to support their theory, but a closer inspection of the data shows that the changes in temperature almost always precede the changes in CO<sub>2</sub> by several hundred to a thousand years. The same precedence is observed in the most recent glacial warming being experienced. This suggests that a theory of CO<sub>2</sub> as the prime forcing agent for temperature change is mistaken and temperature change itself is the driving force behind the rise in CO<sub>2</sub> levels. Shorter term variations in CO<sub>2</sub> over the last several decades show a similar trend with changes in sea surface temperature inevitably leading to changes in atmospheric CO<sub>2</sub>.

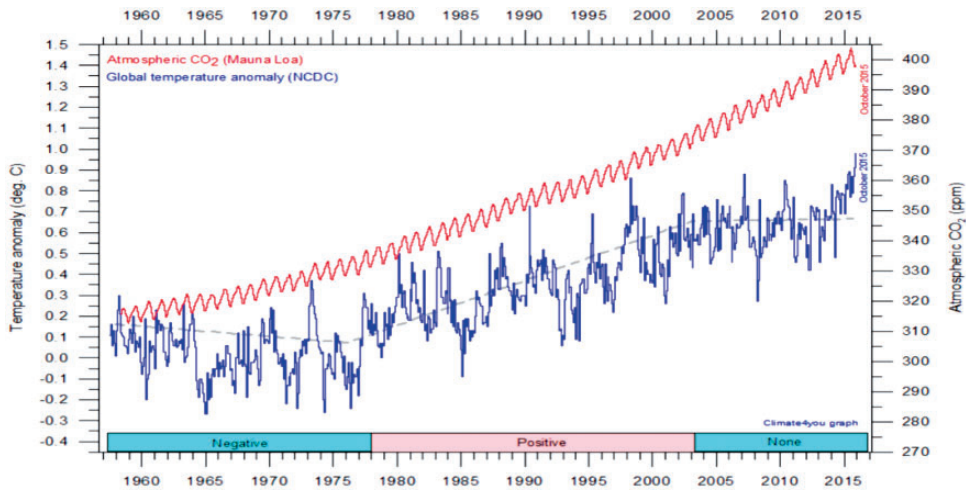
The Vostok data also indicate that anthropogenic CO<sub>2</sub> emissions had no influence on the Earth's temperature as the observed doubling of CO<sub>2</sub> during the warming eras could not have come from human emissions, which were essentially nil 400,000 years ago.

The most likely sources would have been tropical oceans and other natural events such as volcanic emissions, forest fires, vegetative decay and limestone weathering. These same sources are likely responsible for recent increases in atmospheric CO<sub>2</sub>. The amount of CO<sub>2</sub> dissolved in the oceans as carbon is about 50 times greater than the amount in the atmosphere. As the oceans warm, dissolved CO<sub>2</sub> is emitted into the atmosphere, just as soda pop emits CO<sub>2</sub> bubbles when poured into a warmer glass. As oceans cool again, CO<sub>2</sub> dissolves back into the oceans, in the same manner as soda pop being made by injecting CO<sub>2</sub> gas into cold water.

The issue of whether the origin of recent CO<sub>2</sub> increase is principally natural or man-made is important for the veracity of the IPCC paradigm. The implications of the Vostok data, plus the recent OCO-2 satellite measurements (Figure 2), show that the current sources of CO<sub>2</sub> are overwhelmingly natural.<sup>3</sup> They do not correlate with the proclaimed IPCC paradigm.



**Figure 2.** Satellite data from OCO-2 showing CO<sub>2</sub> concentrations across the globe.<sup>3</sup>



**Figure 3.** Average temperatures plotted against atmospheric CO<sub>2</sub> levels.<sup>4</sup>

### Data to support the UN IPCC paradigm

Published data that might appear to support the conclusion that human CO<sub>2</sub> emissions have caused a modest increase in the average temperature of the Earth are shown in Figure 3.

The average monthly surface air temperature anomaly as measured by the National Climatic Data Center is shown in blue and the atmospheric CO<sub>2</sub> concentration in red. CO<sub>2</sub> concentrations are the average monthly values measured at the Mauna Loa Observatory in Hawaii. The dashed gray line indicates the approximate linear trend. The boxes at the bottom of the chart indicate whether a temperature trend is positive or negative relative to the CO<sub>2</sub> trend. The data are taken from Ole Humlum's 'climate4you' website.<sup>4</sup>

The temperature data are shown as 'anomalies' – i.e. as differences in the actual temperatures from their average value base for an extended period of time. Note the anomaly values vary by about 1°C at most, whereas actual temperatures vary by as much as 50°C, reflecting their seasonal or diurnal variations at a given station.

The CO<sub>2</sub> data show a continuous increase from 1958 onward, whereas the temperature trend is downward between 1958 and 1978 (a negative correlation). Between 1978 and 2003, both temperature and CO<sub>2</sub> trend upward (a positive correlation). From 2003 to 2010 the temperature trend is flat (a 'pause' with no correlation) and 2010 to the present is again positive with the El Niño event in the Pacific Ocean being a possible influence. The entire period could end up flat, as happened after the previous El Niño event in 1998.

Over the same time-span, the annual human global emissions of CO<sub>2</sub> show a general increase from 2.5 billion metric tons in 1958 to about 10 billion metric tons currently. This generally positive correlation between atmospheric CO<sub>2</sub> increase and the increase in human CO<sub>2</sub> emissions may prompt one to conclude that human emissions cause a CO<sub>2</sub> increase and, concomitantly, cause temperatures to rise. Such a conclusion is, however, contradicted by the negative correlation between temperature and CO<sub>2</sub> during the period 1958–1978 and the 'pause' from 2003 to 2010.

That a parallel between anthropogenic emissions on the one hand and increased CO<sub>2</sub> and higher temperatures on the other, constitutes a causal relationship, as the IPCC asserts, is

questionable. For, while a parallelism between two separate quantities does not prove that the two are causally related, the lack of parallelism proves that they are not causally related.

From 1958 to 1978 the average global temperature dropped some 0.25°C while human emission of CO<sub>2</sub> from fossil fuels tripled. This CO<sub>2</sub> emission did not contribute to global warming over that period – eliciting suggestions of a coming ice age. Data from 1910 to 1940 indicate a similar increase in temperature as for 1970 to 2000 despite fossil fuel production at that time being around five times lower than it is today!

In 1929, the production of fossil fuels was 1.17 gigatons of carbon per year. Following the stock market crash and the depression, human production decreased to 0.88 gigatons per year – a 30% drop. Yet during that same period both atmospheric CO<sub>2</sub> and temperature continued to rise at around the same rate as before and in 1934 the ‘dust bowl’ began when US temperatures climbed higher than they have been since.

## The accumulation of CO<sub>2</sub> in the atmosphere

Thus far, in our assessment of the IPCC paradigm, we have dealt with what we saw as a lack of objectivity and failure to ask the most important questions. We now examine the position of many man-made climate change advocates, including the IPCC, that CO<sub>2</sub> emitted into the atmosphere by fossil combustion lasts for centuries. Indeed, some even claim that it accumulates for thousands of years and will make the Earth uninhabitable.

The most authoritative study of how long human emission of CO<sub>2</sub> can accumulate in the atmosphere is that of Professor Tom Segalstad of the University of Oslo.<sup>5</sup> His studies show that human emission rapidly dissolves in the cold oceans and is sequestered there as carbonate and bicarbonate ions within a year or two after its emission into the troposphere. Thus the reservoir for CO<sub>2</sub> emitted by humans is not the atmosphere but the oceans. That reservoir is some fifty times larger than the amount contained in the atmosphere. Segalstad’s study of the <sup>13</sup>C/<sup>12</sup>C isotope ratios to be shown in Figure 7 confirms that atmospheric CO<sub>2</sub> is mainly of oceanic origin and not from fossil fuels.

## The actual temperature record

Figure 4 is a plot from the 1990 IPCC report, which shows an early global temperature reconstruction. This depicts the well-established medieval warm period (MWP), which reached its peak in about 1200 AD and then gave way to the little ice age (LIA) that lasted from about 1400 to 1850 AD. Those periods are well documented in history and accepted by climatologists. The Viking colonisation of Greenland took place during the MWP when lush green vegetation thrived, giving it its name. The Viking settlements collapsed during the LIA, when even the Thames in London froze over.

If the Medieval Warm Period was warmer than today, with no greenhouse gas contribution, what would be so unusual about modern times being warm also? Daly<sup>6</sup>

Like the Vostok data, the above temperature curve presented a serious problem to the supporters of AGW. The MWP peaked at a higher temperature than today and at a time when there was no significant human emission of CO<sub>2</sub>. This naturally raised the question: What would be so unusual about the current warming trend that necessitated the response to link it to human CO<sub>2</sub> emissions? In return, the AGW advocates drew attention to a little

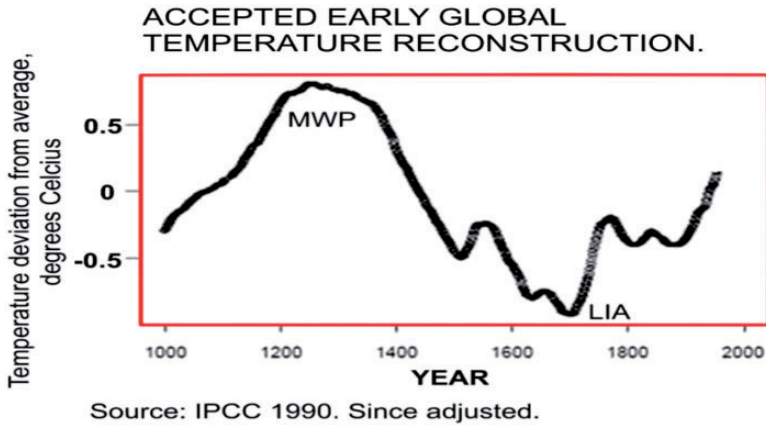


Figure 4. The medieval warm period.

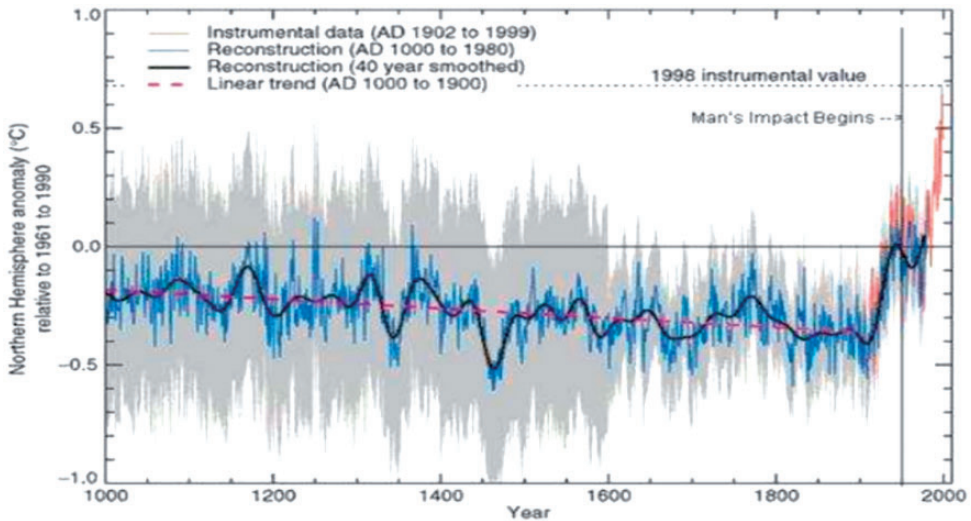


Figure 5. Temperature graph based on tree rings, showing a sudden, sharp, rise.<sup>7</sup>

known 1999 paper using tree ring data to assess past temperatures,<sup>7</sup> eliciting memories of the now infamous presentation of the ‘Hockey Stick’ curve.

Tree rings are not a reliable temperature proxy because they are influenced by many other factors, apart from temperature: rainfall, sunlight, cloudiness, pests, competition from other trees, soil nutrients, frost and snow duration. Nevertheless, the tree ring curve as shown in Figure 5 was accepted by the IPCC and replaced their earlier curve. As can be seen, it has the shape of a hockey stick. Trees grow only on land and 71% of the Earth’s surface is covered by water. The data were only from the Northern Hemisphere, yet presented as the global temperature curve. Quoting John Daly: ‘It was a coup: total, bloodless, and swift, and the hockey stick was greeted with a chorus of approval from the greenhouse effect supporting industry.’<sup>6</sup>

Exhibit 2-1. Global Natural and Anthropogenic Sources and Absorption of Greenhouse Gases

Gas	Biogenic Sources	Anthropogenic Sources	Absorption	Annual Increase in Gas in Atmosphere
CO <sub>2</sub> (mmtCE)	150,000	7,100	154,000	3,100–3,500
CH <sub>4</sub> (mmt gas)	110-210	300-450	460-660	35–40
N <sub>2</sub> O (mmt gas)	6-12	4-8	13-20	3–5

Source: US Department of Energy, Energy Information Administration, *Emissions of Greenhouse Gases in the United States, 1995*, p. 3, citing ranges from Intergovernmental Panel on Climate Change, *Climate Change 1995: The Science of Climate Change* (Cambridge, UK: Cambridge University Press, 1996).

Figure 6. The US DOE citing IPCC figures.

The MWP and the LIA became non-events, consigned to an ‘Orwellian memory hole.’ It was argued that they were strictly local European phenomena and the tree ring hockey stick was duly presented in the media as: ‘New studies indicate that temperatures in recent decades are higher than at any time in the past 1000 years... with the 1990’s as the warmest decade and 1998 as the warmest year.’

Knowledgeable climatologists and other concerned scientists questioned these results and asked for copies of the original data to check the analysis leading to the hockey stick. The authors of the hockey stick initially resisted, delaying release of data and details of the computer program used to analyse the material and the requested e-mail communications among the various authors of the tree ring report have yet to be received. An independent committee of statisticians was appointed to evaluate the tree ring results. The conclusion was that the authors had ‘misused certain statistical methods in their studies, which inappropriately produced hockey stick shapes in the temperature history.’ They also concluded that the claim that the 1990s was the hottest decade in the millennium and 1998 the hottest year could not be supported by the original data.

The UN IPCC ignored the situation and did not refer to it again.

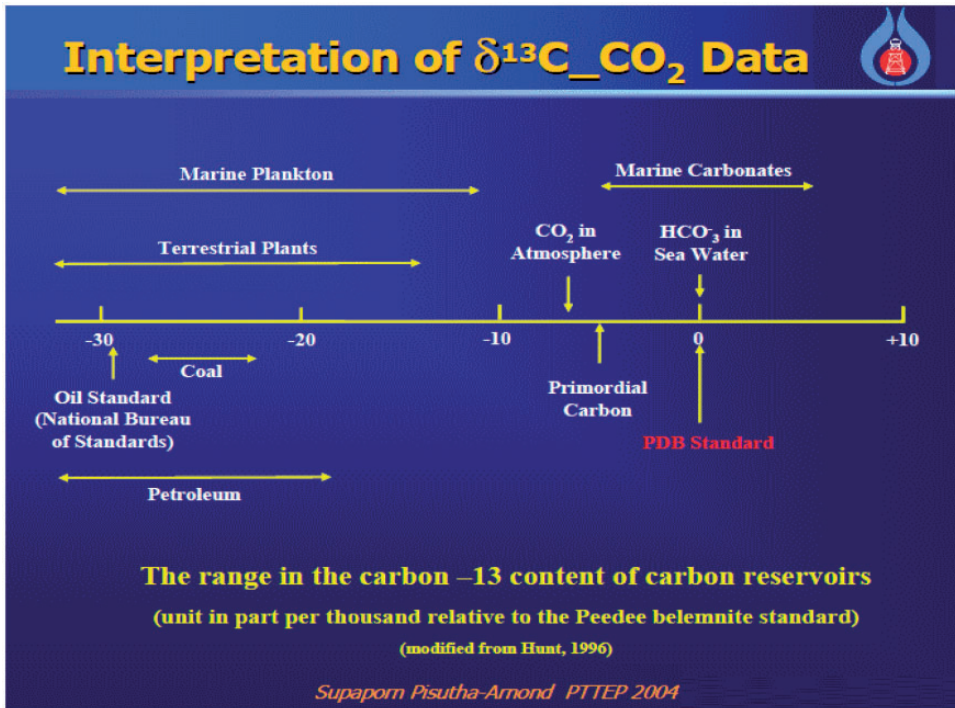
Recent climatological data assembled from around the world using different proxies attests to the presence of both the MWP and the LIA in the following locations: the Sargasso Sea, West Africa, Kenya, Peru, Japan, Tasmania, South Africa, Idaho, Argentina and California. These events were clearly world-wide and in most locations the peak temperatures during the MWP were higher than current temperatures.

## Sources and sinks of atmospheric CO<sub>2</sub>

An issue of critical importance with regard to the IPCC’s paradigm is the origin of the recent increases in CO<sub>2</sub>. Are they natural or caused by fossil fuel combustion? The question has been covered earlier in this paper. The preponderance of evidence suggests that human emission is not a significant factor in the increase. Indeed, as shown below, previous IPCC publications, which are no longer available online, calculated human CO<sub>2</sub> emissions to be around 4–5% of the global total (Figure 6).

Natural carbon sources substantially overwhelm human emissions. The sinks that balance those sources in geologic time are the dissolution of CO<sub>2</sub> into the cold oceans, its circulation within the oceans, photosynthesis to form plant matter, its use by ocean organisms to form exoskeletons and its inorganic precipitation as calcium carbonate (CaCO<sub>3</sub>).

Satellite data confirm Segalstad’s analysis of the <sup>13</sup>C/<sup>12</sup>C ratio for CO<sub>2</sub> in the atmosphere.<sup>9</sup> He showed that the isotopic ratio in the atmosphere today is not much different



**Figure 7.**  $^{13}\text{C}$  abundances on Earth.<sup>9</sup>

to that which it had been in the pre-industrial era. Since fossil fuels are rich in  $^{12}\text{C}$ , their combustion would disturb the ratio and Segalstad's measurements uncovered little isotopic difference between the current and the pre-industrial atmosphere, a clear sign that fossil fuels are not the principal source of atmospheric  $\text{CO}_2$  increases (Figure 7).

Both the satellite data and the isotope ratio data support Segalstad's conclusion that fossil fuels are not a significant source of atmospheric  $\text{CO}_2$ . That conclusion is reinforced by the Vostok data for the millions of years prior to the industrial age when human fossil combustion was essentially nil yet atmospheric  $\text{CO}_2$  doubled between glacial cooling and interglacial warming eras.

There is a substantial amount of recent global data from European, American and Japanese satellites that measure the total atmospheric  $\text{CO}_2$  worldwide. The data are difficult to access and where published, their authors' interpretations have appeared 'primitive' and 'cherry-picked' to conform to the agency's 'party line' about the dangers of 'greenhouse gases.' Examples of such satellite data are depicted in the earlier Figure 2 and Figure 8.

More significantly, the data from those figures show that  $\text{CO}_2$  levels above the industrialised US and Western Europe are some 25 ppmv lower than the values over the Amazon and sub-tropical Africa. With their lush vegetation those tropical rain forests would be expected to be a photosynthesis sink, yet the data show high levels that would be characteristic of a source.

The agencies collecting the data suggest that the high  $\text{CO}_2$  levels are caused by 'burning of savannas and forests.' The data also show that the tropical latitudes over both land and water are major sources.



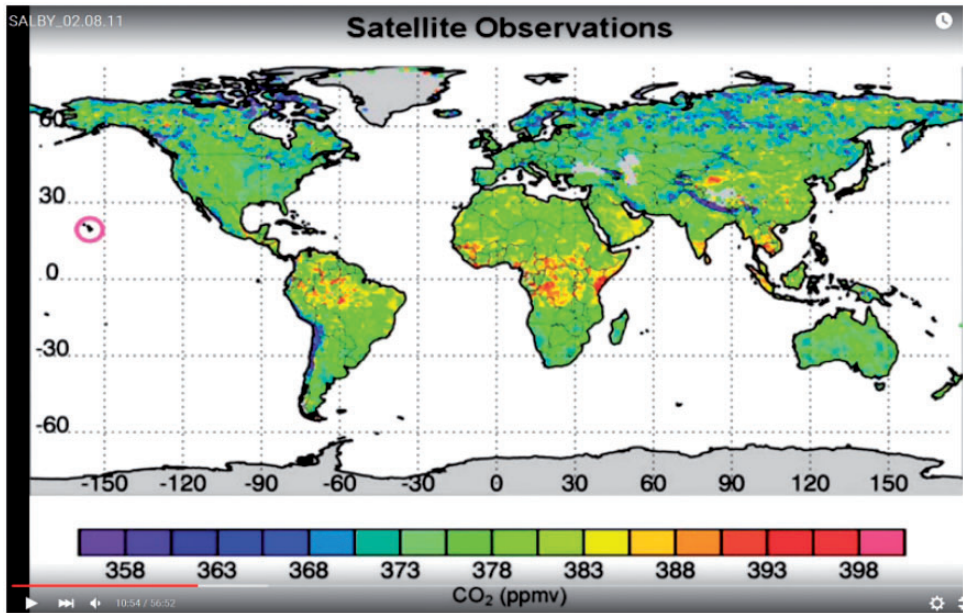


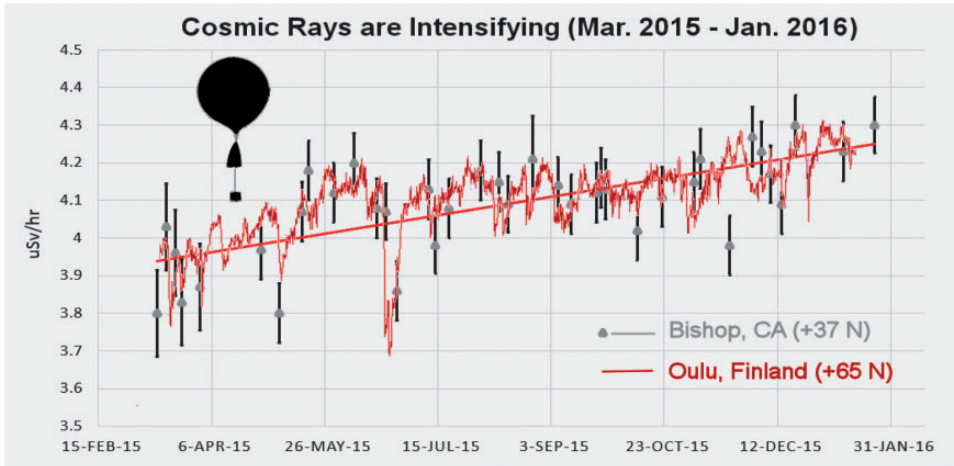
Figure 8. CO<sub>2</sub> concentrations across the globe.<sup>10</sup>

A complete analysis of the totality of the data to explain both the geographic and seasonal variations is needed. Such an explanation was provided by Rörsch et al.<sup>11</sup> and has recently been expanded by Salby.<sup>12</sup> As was also shown in the Vostok data, the satellites show that the major factor in determining the atmospheric concentrations of CO<sub>2</sub> is the temperature and not human emissions.

## Reality

The forces and motions in the oceans and atmosphere are driven mainly by the following:

- The motions of the Earth relative to the Sun: periodic changes in its elliptical orbit, its rotation about its polar axis, changes in the tilt of that axis and its wobble or precession.
- Solar activity variations that influence the radiant energy reaching the Earth and also modulate cosmic ray activity, which influences cloud cover and cloudiness.<sup>8</sup>
- The distribution of land and water on the Earth's surface, which controls its temperature distribution, moisture availability, monsoon effects, hurricanes and other storm tracks.
- The topography of the Earth's surface, which causes copious precipitation on the windward side of mountains and aridity on the leeward side.
- Fluid motions within the Earth's oceans that determine moisture availability and ocean surface temperatures (El Niño and La Niña cycles).
- Volcanic eruptions that inject huge amounts of dust into the atmosphere, increasing the Earth's albedo and periodically inhibiting sunlight from reaching the Earth's surface.
- Known and yet-to-be charted underwater volcanic eruptions, including the recently discovered 'black smokers' that spew super-heated water continuously. They are expected to



**Figure 9.** Cosmic ray measurements are intensifying.<sup>14</sup>

number in the hundreds of thousands. The ocean floor is less well-known to science than the surfaces of the Moon and Mars.

Water in all its forms is the main agent through which those forces operate. Water provides vapour in the atmosphere, heat transport by evaporation and condensation and the vast circulating mass of the oceans where heat capacity dominates. Finally, it provides the cloud, snow and ice cover that influences the Earth's albedo and, thus, plays a part in the radiative balance between the Sun, the Earth and free space.

## Cosmic rays

For the past year, neutron monitors<sup>13</sup> near the Arctic Circle have recorded an increasing intensity of cosmic rays. In the plot below, neutrons monitored by the University of Oulu Cosmic Ray Station are traced in red; gamma-ray/X-ray measurements over California are in gray.

Increased cosmic ray penetration is making itself felt not only over the poles, but also over lower latitudes where Earth's magnetic field provides greater protection against deep space radiation (Figure 9).

This type of radiation through our atmosphere is modulated by solar activity. Solar storms and coronal mass ejections<sup>15</sup> tend to sweep aside cosmic rays, making it more difficult for them to reach the Earth. Conversely, low solar activity allows an extra dose of cosmic rays to penetrate. Indeed, the ongoing increase in cosmic ray intensity is probably due to a decline in the solar cycle.

Solar maximum of cycle 24 has already passed and we are heading toward a new solar minimum.<sup>16</sup> NASA forecasters expect solar activity to drop sharply in the years ahead and cosmic rays are poised to increase accordingly. More cosmic rays will increase cloud cover across the globe and together with the expected solar minimum will drive global temperatures downward.

Those are the well-established factors that control weather and climate and recognised by meteorologists for over a century. Carbon dioxide is known to be essential for life on Earth and a 0.04% CO<sub>2</sub> presence is more likely to be beneficial rather than disastrous. The idea that a constituent of that scale in the atmosphere could control or significantly influence the listed natural forces would not seem feasible, particularly in the absence of proven evidence.

## **Conclusion**

As demonstrated, empirical evidence does not support the claim that anthropogenic CO<sub>2</sub> emissions cause global warming and/or climate change. We suggest that without adequately proven evidence being demonstrated – should it exist in the first place – such a conclusion can not be adduced from the known facts.

## **Dedication**

This paper is dedicated to the memory of Alexander Cockburn, a journalist and author whose careful study of the available meteorological data resulted in a series of articles published in the Nation Magazine (14 May 2007 to 25 June 2007). These articles represent a challenge to the prevailing paradigm that human CO<sub>2</sub> emissions from fossil fuel combustion are warming the globe and disrupting the climate. Below is his introduction to that series.

In time to come historians will be comparing the frenzies over our supposed human contribution to global warming to the tumults at the latter half of the tenth century as the Christian millennium approached. Then as now, the doomsters identified human sinfulness as the propulsive factor in the planet's downward slide. Then as now, a buoyant market thrived on fear. The Roman Catholic Church sold indulgences like checks. The sinners established a line of credit against bad behavior and could go on sinning. Today a world market in 'carbon credits' is in formation. Those whose 'carbon footprint' is small can sell their surplus carbon credits to others less virtuous than themselves.

The modern trade is as fantastical as the medieval one. There is still zero empirical evidence that anthropogenic production of carbon dioxide is making any measurable contribution to the world's present warming trend. The greenhouse fear mongers rely on unverified, crudely oversimplified models to finger mankind's sinful contribution – and carbon trafficking, just like the old indulgences, is powered by guilt, credulity and greed.

The editors of Nation Magazine felt compelled to dissociate themselves from Cockburn's analysis and publish only articles by environmental groups who adhere to the consensus that global warming/ climate change is of anthropogenic origin and an existential threat. They do not countenance scientists who challenge that paradigm.

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**Martin Hertzberg** was first trained as a meteorologist at the US Naval Postgraduate School and served as a forecasting and research aerologist at the Fleet Weather Central in Washington DC. He subsequently obtained a PhD in Physical Chemistry at Stanford and later served as a Fulbright Professor. Dr Hertzberg established and supervised the explosion testing laboratory at the U. S. Bureau of Mines facility in Pittsburgh (now NIOSH). Test equipment developed in that laboratory has been widely replicated and incorporated into ASTM standards. Published test results from that laboratory are used for the hazard evaluation of industrial dusts and gases. Dr Hertzberg is an internationally recognised expert on combustion, flames, explosions and fire research with over 100 publications in those areas. While with the Federal Government he served as a consultant for several Government Agencies (MSHA, DOE, NAS) and professional groups (such as EPRI). He is the author of two US patents: (1) sub-micron particulate detectors, and (2) multi-channel infra-red pyrometers. Dr Hertzberg is also a long time climate writer and in recent years, his interests have returned to weather prediction and he is a well-published skeptic of anthropogenic global warming/climate change.

**Hans Schreuder** trained as an analytical chemist in The Hague and spent 15 years working in that field, testing pharmaceutical products as well as researching the recycling of plastics and rubber. For another 15 years, he gained extensive experience as an international technical contractor, including writing quality control manuals whilst working in South Africa. He was accepted as a member of MENSA after passing the relevant tests. Schreuder has long been a staunch and highly regarded critic of the greenhouse gas theory and outspoken commentator, using his two websites as a publishing hub for fellow scientists critical of the theory. Schreuder has written many articles on the subject and in May 2009 submitted a 109-page written report, supplemented with a 45-min oral submission, to the Northern Ireland Climate Change Committee.