The Myth of Dangerous Human-Caused Climate Change

R M Carter[1]

Whether dangerous human-caused climate change is a fact, possibly a fact or a fabrication depends on who you choose to believe. Many of us line up somewhere between probable and possible on this spectrum. (John Roskam, *Australian Financial Review*, 2006.)

I have been dismayed over the bogus science and media hype associated with the (dangerous) human-induced global warming hypothesis. My innate sense of how the atmosphere-ocean functions does not allow me to accept these scenarios. Observations and theory do not support these ideas. (Professor Emeritus William Gray, Colorado State University, 2006.)

ABSTRACT

Human-caused global warming has become the environmental *cause celebre* of the early 21st century. The strong warming alarmist camp currently includes the United Nations, most Western governments, most of the free press, many large corporations (including Enron, before it failed), the major churches, most scientific organisations and a large portion of general public opinion. This phalanx of support notwithstanding there is no scientific consensus as to the danger of human-induced climate change. There is, therefore, a strong conflict between the level of public alarm and its scientific justification. How can this be?

In a democracy, the media serve to convey to the public the facts and hypotheses of climate change as provided by individual scientists, governmental and international research agencies, and NGO and other lobby groups. In general, the media have promulgated an alarmist cause for climate change; they have certainly failed to convey the degree of uncertainty that is characteristic of climate science, or a balanced summary of the many essential facts that are relevant to human causation.

Climate change is as much a geological as it is a meteorological issue. Natural climate changes, both warmings and coolings, are indeed a societal hazard. We usually deal with geological hazards by providing civil defence authorities and the public with accurate, evidence-based, general information about events like earthquakes, volcanic eruptions, tsunamis and floods, and then by adapting to the effects when a damaging event occurs. As for other major natural disasters, the appropriate preparation for extreme climate events is to mitigate and manage the negative effects when they occur, and especially so for dangerous coolings. Attempting instead to 'stop climate change' by reducing human carbon dioxide emissions is a costly exercise of utter futility. Rational climate policies must be based on adaptation to dangerous change as and when it occurs, and irrespective of its sign or causation.

The issue now is no longer climate change as such, the reality of which will always be with us. Rather, the issues are, first, the failure of the free press to inform the public about the true facts of human-caused climate change and of the dangers posed by natural climate change. And, second, the vested interests held by many of the groups of warming alarmists. These interests include not only the obvious commercial ones, but also the many scientists and science managers who have discounted or remained silent about the huge uncertainties of the human-caused global warming hypothesis because it suited them to do so. Public opinion will soon demand an explanation as to why experienced editors and hardened investigative journalists, worldwide, have melted before the blowtorch of self-induced guilt, political correctness and special interest expediency that marks the sophisms of global warming alarmists.

1. Professor, Marine Geophysical Laboratory (Node C), Sporing Road South, James Cook University, Townsville Qld 4811.
Email: bob.carter@jcu.edu.au

INTRODUCTION

In a recent letter to European heads of state, British Prime Minister Tony Blair wrote: 'We have a window of only ten to 15 years to take the steps we need to avoid crossing a catastrophic (climate) tipping point'. In contrast, Emeritus Professor Gray, a distinguished climate scientist from the University of Colorado, said recently 'Observations and theory do not support these ideas (of dangerous human-caused warming)'. These statements cannot both be true. Who is right, and how should members of the public make up their minds on the matter?

That climate changes frequently, rapidly and sometimes unpredictably has been conventional knowledge amongst earth environmental scientists since the early days of ocean drilling in the 1970s. Yet we do not read about such *natural* climate change in the everyday news. Instead, in 2007 the daily media, in pursuit of circulation needs, is full of doom and gloom about *human-caused* global warming. Climate alarmism is propagated by a diverse group of journalists, environmental lobbyists, scientific and business groups, church leaders and politicians, all of whom preach that we must 'stop climate change' by severely reducing human carbon dioxide emissions, two propositions that compete in impracticality.

There are many qualified persons who argue against such an alarmist interpretation of recent and likely future climate change. I am one. When referred to politely, such persons are badged as 'climate sceptics'; nearly as often they are disparaged as 'climate septics', 'climate deniers' or 'flat earthers'. The denigration implicit in the word sceptic is interesting in itself, because virtually all scientists – whether they support the alarmist views of the UN's Intergovernmental Panel on Climate Change (IPCC) or are of more independent mind – accurately view themselves as professional sceptics, for that is what scientists are trained to be. A more appropriate term for persons who are critical (on balanced scientific grounds) of the IPCC's alarmism is either 'climate agnostics' or 'climate rationalists' – the latter term, in particular, reflecting the primacy that such persons give to empirical data and thinking. The climate rationalist approach contrasts markedly with the untestable worlds of computer virtual reality that so many climate alarmists now inhabit.

Much public discussion on global warming is underpinned by two partly self-contradictory assumptions. The first is that there is a 'consensus' of qualified scientists that dangerous human-caused global warming is upon us; and the second is that although there are 'two sides to the debate', the dangerous-warming side is overwhelmingly the stronger. Both assertions are unsustainable. The first because science is not, nor ever has been, about consensus, but about experimental and observational data and testable hypotheses. Second, regarding the number of sides to the debate, reality is that small parts of the immensely complex climate system are better or less understood – depending upon the subject – by many different groups of experts. No one scientist, however brilliant, 'understands' climate change, and there is no general theory of climate nor likely to be one in the near future. In effect, there are nearly as many sides to the climate change debate as there are expert scientists who consider it.

Some key questions and answers that are relevant to the climate change debate include the following. Is there an established Theory of Climate? Answer: no. Do we understand fully how climate works? No. Is carbon dioxide demonstrated to be a dangerous atmospheric pollutant? No. Can deterministic

computer models predict future climate? Another no. Is there a consensus amongst qualified scientists that dangerous, human-caused climate change is upon us? Absolutely not. Did late 20th century temperature rise at a dangerous rate, or to a dangerous level? No, in either case. Is global temperature currently rising? Surprisingly, no. And finally, is the IPCC a scientific or a political advisory body? Answer: it is both.

This paper provides an analysis of these questions and some related issues. It is intended to provide easy reading more than to be an exhaustive analysis of the published scientific research that underpins its conclusions. Readers interested in more detail and a more complete bibliography should consult publications such as Carter *et al* (2006); de Freitas (2002); Gerhard, Harrison and Hanson (2001); IPCC (2001); Khandekar, Murty and Chittibabu (2005); Khilyuk and Chilingar (2006); Kininmonth (2004); Lindzen (2006); Jaworowski (2007) and Philander (1998), or browse some of the web sites listed later.

THEORY OF CLIMATE

There is no established theory of climate in the sense that there is a theory of Newtonian mechanics. It is part of the nature of established theories that they have been repeatedly tested against empirical data, from which derives their predictive power. Such theories have their birth in hypotheses.

The currently favoured hypothesis of dangerous global warming includes the presumption that late 20th century warming was substantially caused by human emissions of the greenhouse gas carbon dioxide. As will be elaborated later, this theory has failed the three main tests to which it has been subjected. First, no close relationship exists between the 20th century patterns of increasing carbon dioxide and changing temperature; second, 20th century rates and magnitude of temperature change fall well within previous natural limits of change despite accompanying increases in human-sourced carbon dioxide; and, third, the deterministic computer models that are used to engender public alarm have proved unable to predict the course of temperature change over the period 1990 - 2006, let alone out to 2100.

Richard Lindzen, the distinguished US atmospheric scientist, recently wrote in the UK Telegraph: 'After all, like hurricane frequency or the price of oil, global mean temperature is as likely to go down as up'. This observation, which is accurate, suggests that if there is to be a theory of climate for frequencies shorter than Milankovitch-scale variations (100 000, 41 000 and 19 000/ 23 000 year climate cycles) then it might turn out to be that climate changes stochastically, as indeed has recently been suggested by Ditlevsen (2007) for the millennial cycles termed Dansgaard-Oeschger events. Instead, in place of such a theory at the moment there is a hypothesis of anthropogenic global warming (AGW). It has been tested, and fails.

HOW DOES CLIMATE WORK?

If there is no theory of climate, then how much do we know about how climate works? The answer – as detailed in such useful references as Philander (1998), IPCC (2001), Ruddiman (2001), Kininmonth (2004) and Singer and Avery (2006) – is 'a very great deal, though not yet enough to predict its future with any certainty'. And we would certainly hope that the first part of this answer were true, because at least US$50 billion dollars has been expended on climate change research since 1990. As discussed in more detail later, it is noteworthy that this large expenditure, and the extended efforts of the many talented scientists supported by it, have in 2007 still not provided convincing evidence for a measurable human effect on global climate.

There are many subdisciplines of research relevant to climate change, including meteorology, climatology, atmospheric chemistry and physics, geology, palaeoceanography, quaternary science, mathematics-statistics and modelling. So different groups of scientists know a lot about different parts of the climate jigsaw. The subdisciplines at the beginning of this list are concerned mostly with weather and climate *processes*, those in the middle with climate *history*, and the two at the end with *data processing and virtual reality*. The climate advice that governments receive, mostly through the IPCC, is heavily influenced by scientists whose prime interests are climate processes and imaginary virtual reality, and very light-on on information from experts in ancient climate change. And therein lies one of the fatal weaknesses of the IPCC.

IS CARBON DIOXIDE A DANGEROUS POLLUTANT?

Carbon dioxide (CO_2) is a colourless, odourless gas that has been present in earth's atmosphere through time in trace amounts ranging from a few hundred to a few thousand parts per million (ppm). Average atmospheric values over the last few hundred thousand years are inferred from ice cores to have been about 180 ppm during glacials and 280 ppm during interglacials (eg Petit *et al*, 1999) (Figure 1). Hurd (2006), Jaworowski (2007) and others have argued that these values are about 30 - 50 per cent lower than the original atmospheric values that they purport to represent, because of the post-depositional diffusion and mixing that occurs within the compacting ice mass. Independent evidence from fossil plant stomata indicates that carbon dioxide levels during the Holocene were variable on a decadal-centennial scale compared with the monotonic curve delineated by the ice cores (Figure 1, inset), and reached at least the present day (post-industrial) value of 380 ppm (Kurschner *et al*, 1996; Wagner, Aaby and Visscher, 2002; Kouwenberg *et al*, 2005) (Figure 2). More support for decadal fluctuations of carbon dioxide comes from the compilation and summary of 90 000 historical atmospheric analyses back to the mid-19th century by Beck (2007).

In any case, and irrespective of these uncertainties, all estimates of carbon dioxide levels during the recent past are very low by the standards of earlier geological history, for planetary carbon dioxide values have declined from around 1000 ppm in the early Cenozoic, 60 million years ago (Lowenstein and Demicco, 2006) (Figure 3). It is therefore crystal clear that there is nothing inherently unusual, nor necessarily dangerous, about the 'extra' carbon dioxide that is currently being contributed to the atmosphere by human activity, which anyway amounts annually to only about three per cent of the natural flux. Together with oxygen, carbon dioxide is a staff of life for earth's biosphere because the metabolism of plants depends upon its absorption. Increasing carbon dioxide in the range of about 200 - 1000 ppm has repeatedly been shown to be beneficial for plant growth, and to increase plants' efficiency of water use (Eamus, 1996; Saxe, Ellsworth and Heath, 1998; Robinson *et al*, 1998). Prima facie, therefore, there is no reason to assume that atmospheric carbon dioxide levels of 500 - 1000 ppm are dangerous, or that such levels would have dramatically adverse ecological effects. Rather, increasing atmospheric carbon dioxide over this range is mostly beneficial (Idso, 2001; and many papers listed at the web site CO_2 Science).

Following from this discussion, that carbon dioxide is, by definition, not a pollutant has been a cause of constant exasperation to those environmental activists who fear global warming. This exasperation underlies a current US Supreme Court case brought by the State of Massachusetts against the Environmental Protection Agency. Those bringing the action hope that the Court will declare that carbon dioxide should come under the Clean Air Act, and thereby be defined as a 'pollutant' and require regulation by the US Environmental Protection Agency.

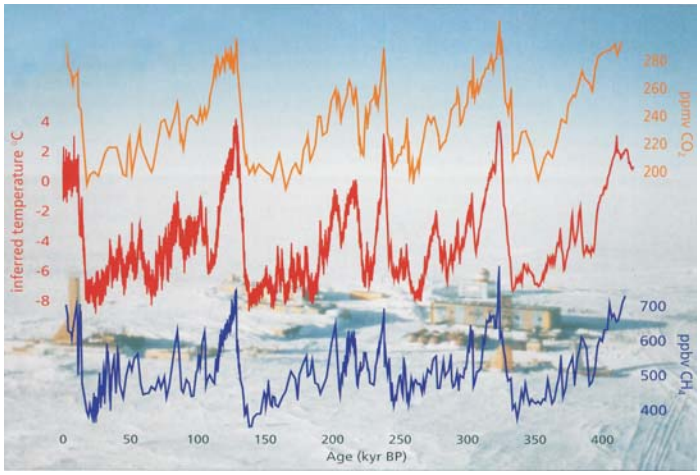

FIG 1 - Atmospheric carbon dioxide, temperature and methane levels for the last 420 000 years as reconstructed from the Vostok ice core, Antarctica (after Petit *et al*, 1999). Note the remarkable coincidence of timing of variations in atmospheric temperature (middle curve) and the two greenhouse gases. In terms of cause and effect, however, it is apparent at higher resolution that the changes in temperature *precede* the changes in carbon dioxide by about 800 years (eg Mudelsee, 2001).

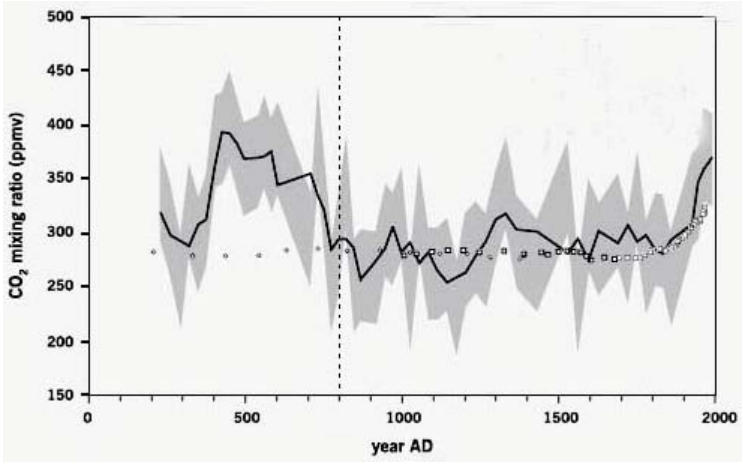

FIG 2 - Reconstruction of paleo-atmospheric carbon dioxide levels for the last 1800 years inferred from stomatal density in fossil pine needles (Tsuga heterophylla), northwestern USA (after Kouwenberg, 2005, Figure 5.4). Black line: three-point running average, based on 305 needles per data point; grey shading: error estimate. Open diamonds and squares indicate, respectively, measurements from the Taylor Dome and Law Dome ice cores, Antarctica. The ice core data represent generalised averages, and appear not to preserve the decadal-centennial changes in atmospheric carbon dioxide indicated by the stomatal measurements.

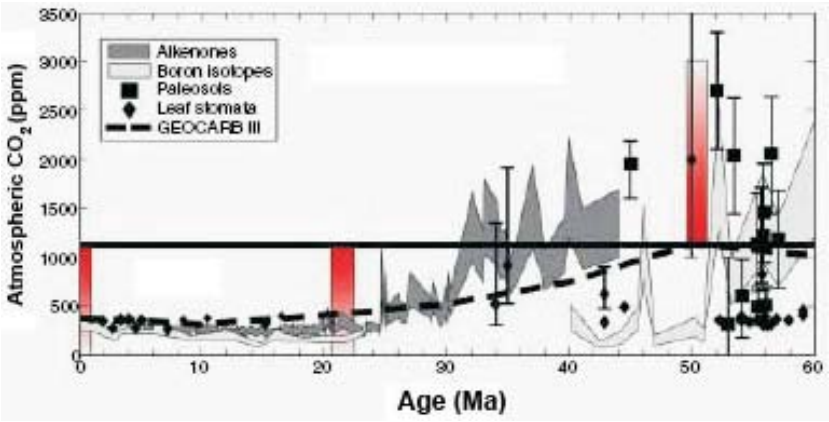

FIG 3 - Atmospheric carbon dioxide levels for the last 60 million years, reconstructed from leaf stomata, boron isotopes, paleosols, alkenones and the GEOCARB III geochemical model; wide bars at ~1, 22 and 50 million years BP are estimates from the Green River (nahcolite), Beypazari and Searles Lake trona deposits (after Lowenstein and Demicco, 2006, Figure 1). Despite the variability inherent in estimates using such a wide range of methods, the data indicate enhanced levels of ~1500 ppm in the early Cenozoic, 60 million years ago, declining to a few hundred ppm by 20 million years ago. Modern biota therefore live in a carbon dioxide-impoverished environment compared with their recent ancestors.

Though not a pollutant, it is nonetheless the case that carbon dioxide absorbs space-bound infrared radiation, thereby increasing the energy available at Earth's surface for warming or increased evaporation (eg de Freitas, 2002). Radiation theory thus accepted, there remain four problems with turning an increase in atmospheric carbon dioxide into global warming alarmism. First, the relationship between increasing carbon dioxide and increasing temperature is logarithmic, which lessens the forcing effect of each successive increment of carbon dioxide (Figure 4). Second, in increasing from perhaps 280 ppm in pre-industrial times to 380 ppm now, carbon dioxide should already have produced 75 per cent of the theoretical warming of ~1°C that would be caused by a doubling to 560 ppm (Lindzen, 2006); as we move from 380 to 560 ppm, at most a trivial few tenths of a degree of warming remain in the system. Claims of greater warming, such as those of the IPCC (2001), are based upon arbitrary adjustments to the lambda value in the Stefan-Boltzmann equation, and untested assumptions about positive feedbacks from water vapour. Third, the ice core data show conclusively that, during natural climate cycling, changes in temperature precede changes in carbon dioxide by an average 800 years or so (Fischer *et al*, 1999; Indermuhle *et al*, 2000; Mudelsee, 2001; Caillon *et al*, 2003); similarly, temperature change precedes carbon dioxide change, in this case by five months, during annual seasonal cycling (Kuo, Lindberg and Thomson, 1990). And, fourth, Boucot, Xu and Scotese (2004) have shown that over the Phanerozoic little relationship exists between the atmospheric concentration of carbon dioxide and necessary warming, including that extensive glaciation occurred between 444 and 353 million years ago when atmospheric carbon dioxide was up to 17 times higher than today (Chumakov, 2004).

In summary, there is almost universal agreement that significant carbon dioxide increases – human-caused or otherwise – will cause gentle planetary warming. But scientific opinion remains strongly divided as to how great a warming would accompany a real world doubling, and whether any such warming will on balance be beneficial or harmful.

CAN COMPUTER MODELS PREDICT FUTURE CLIMATE?

General circulation computer models (GCMs) are deterministic, which is to say that they specify the climate system from the first principles of physics. For many parts of the climate system, such as the behaviour of turbulent fluids or the processes that occur within clouds, our knowledge of the physics is incomplete, which requires the extensive use of parameterisation (read 'educated guesses') in the computer models. The modellers themselves acknowledge that they are unable to predict future climate, preferring the term 'projection' to describe the output of their experiments which the IPCC then incorporates into socioeconomic 'scenarios' (eg IPCC, 2001). This terminology highlights the fact that GCMs are unvalidated and do not provide skilled predictions of future climate out to 2100. Also, it transpires, first, that none of the models was able to forecast the path of the global average temperature statistic as it elapsed between 1990 and 2006. And, second, GCMs persistently predict that greenhouse warming trends should increase with altitude, especially in the tropics, with the highest trends at around 10 km height; in contrast, actual observations show the opposite, with either flat or decreasing trends with increasing height in the troposphere (CCSP, 2006).

Individual GCMs differ widely in their output under an imposed regime of doubled carbon dioxide. The IPCC (2001, Figure 5d) cites a range of 1.8 to 5.6°C warming by 2100 for the model outputs that they favour, but this range can be varied further to even include negative outputs (ie cooling) by minor adjustment of some of the model parameters (Essex and McKitrick, 2002). When climate modelling experiments produce such cooling, the output is discarded as 'obviously wrong' (Stainforth *et al*, 2005).

A second use of GCM modelling is in climate attribution studies, whereby the known 20th century meteorological record is retrodicted using models fed with known or presumed forcings, such as increasing carbon dioxide, volcanic eruptions and other aerosols (eg Stott *et al*, 2001; Hulme *et al*, 2002, Figure 4). After many years of trials, the IPCC (2001, Figure 12.7) reported simulations that mimicked the historic temperature record if and only if human emissions were included in the forcings. These results have been widely misrepresented as evidence for human-caused global warming. They are, of course, evidence only that a curve matching exercise involving many degrees of freedom has plausibly mimicked the 20th century temperature curve. They are exercises in virtual reality, and not evidence of any type.

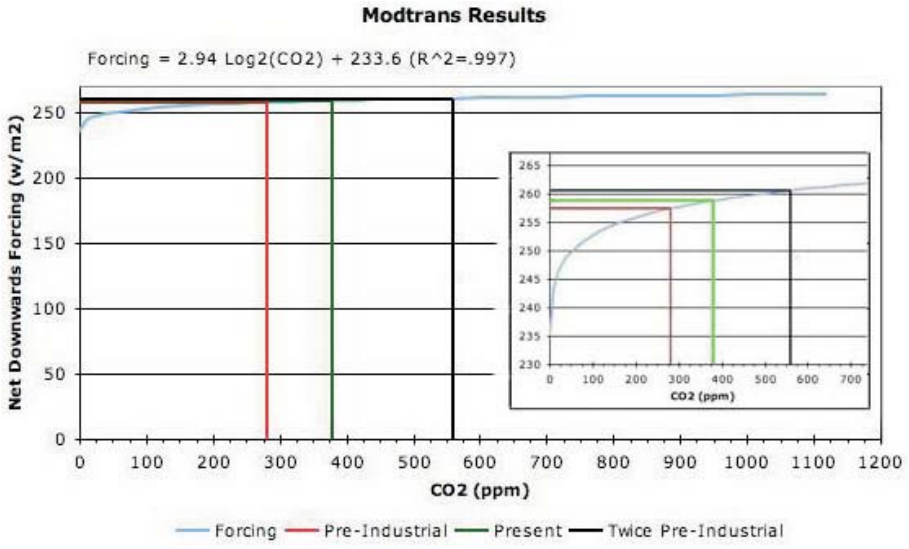

FIG 4 - Incremental increase in forcing caused by addition of carbon dioxide to the atmosphere up to a value of 1200 ppm (inset: data plotted with non-zeroed y-axis, to clarify incremental warming over the 200 - 500 ppm range). Note that an increase of 4.5 w/m^2 equates to a temperature increase of ~1°C. Note also the logarithmic relationship between increasing carbon dioxide and total downward radiation flux. Forcing estimated using MODTRANS modelling (graphs courtesy W Eschenbach).

As an alternative to the deterministic GCM approach, there exist several other types of computer model of empirical nature. Such models use analysis of a portion of the climate record to establish the pattern of past temperature change and then project this pattern into the future. Papers include Kotov (2001; application of chaos theory to last 50 000 years of Greenland ice core data), Klyashtorin and Lyubushin (2003; analysis of last 150 year record of the global average temperature statistic), Loehle (2004; analysis of last 5000 years of temperature record contained in a Caribean deep sea core and a South African speleothem) and Zhen-Shan and Xian (2007; analysis of Chinese temperature record from 1881 - 2002). These papers yield almost unanimous estimates of 21st century cooling rather than warming (eg Figure 5). Unlike GCM scenarios, the results are consistent with the observation that global average temperature peaked in the El Nino year of 1998 and has remained static or slightly declined since (cf Figure 6). In parallel studies rooted in solar physics, projection of the cyclic historic pattern of sunspot activity suggests that a forthcoming 21st century cooling will be driven by falling solar activity, perhaps even to the level of the cold Maunder minimum in the 17th century (Bashkirtsev and Mashnich, 2003; Abdussamatov, 2006).

To summarise, empirical computer projections of 21st century cooling are more consistent with the available data than the greenhouse warming projected by GCMs. Though deterministic GCMs are a valuable heuristic tool, they all rest upon the Kelvin fallacy, ie the assumption that the physics of the system is fully known. In essence, GCMs do not produce accurate climate predictions and they are therefore unsuitable for direct use in policy making (Khandekar, 2004).

IS THERE A CONSENSUS?

Argument based on consensus is not usual in science, for reasons that have been summarised by writer Michael Crichton:

> *Let's be clear: the work of science has nothing whatever to do with consensus. Consensus is the business of politics. Science, on the contrary, requires only one investigator who happens to be right, which means that he or she has results that are verifiable by reference to the real world. In science consensus is irrelevant. What is relevant is reproducible results. The greatest scientists in history are great precisely because they broke with the consensus …*

It would be hard to write a more accurate statement about the way that science works than Crichton's pithy summary. It can be noted in support that we do not usually say that 'there is a consensus that the sun will rise tomorrow'. Instead, the confident statement that 'the sun will rise tomorrow' rests on repeated empirical testing and the understanding conferred by Copernican and Newtonian theory. Therefore, statements such as 'there is a consensus that dangerous global warming will occur' convey sociological rather than scientific information. Individuals, organisations and governments that espouse such views signal mainly that they have a political agenda.

It needs to be stressed that the claimed 'consensus' advice to policy makers provided by the IPCC is political, rather than exclusively scientific as portrayed in the press. Complaints from climate rationalists that the first, second and third IPCC reports were subject to political manipulation centred on the over-egging of the case for dangerous human-caused warming. Significantly, the recent release of the Fourth Assessment Report (4AR; IPCC, 2007) was greeted by strong criticisms also from *supporters* of the dangerous warming case; they allege that bureaucrats involved in the preparation of 4AR removed statements by scientists that highlighted climate risks, and that 4AR therefore understates the risk of catastrophic warming. Thus David Wasdell (2007), an IPCC reviewer, writes that he was '*astounded at the alterations* (to the final scientific draft of the full 4AR report) *that were imposed by government agents during the final stage of review*'. It obviously matters not whether bureaucratic interference results in exaggerating the climate change risks or minimising them; in either case, and as is now agreed by both main sides to the global warming dispute, the 'consensus' advice tendered to governments by the IPCC is political and not scientific.

CAN WE MEASURE AVERAGE SURFACE GLOBAL TEMPERATURE MEANINGFULLY?

Essex, McKitrick and Andresen (in press) have recently argued that climate change cannot be summarised adequately by a simple statistical average of temperatures from around the globe. They assert that no average global temperature calculated for the Earth (and many different averages are possible) can have any physical meaning in the context of climate change, any more than an average telephone number has any meaning for using the telephone system. A temperature can be defined only for a homogeneous system, which climate most definitely does not represent. The processes which control climate, such as ocean currents and atmospheric circulation, are driven by local and regional temperature *differences*, not by a 'global average temperature' statistic.

Let us ignore these arguments for a moment. Like the IPCC – which has widely promulgated a global average temperature curve based on surface thermometer readings since 1860 (IPCC, 2001, Figure 2) (Figure 6) – let us assume that the concept of an

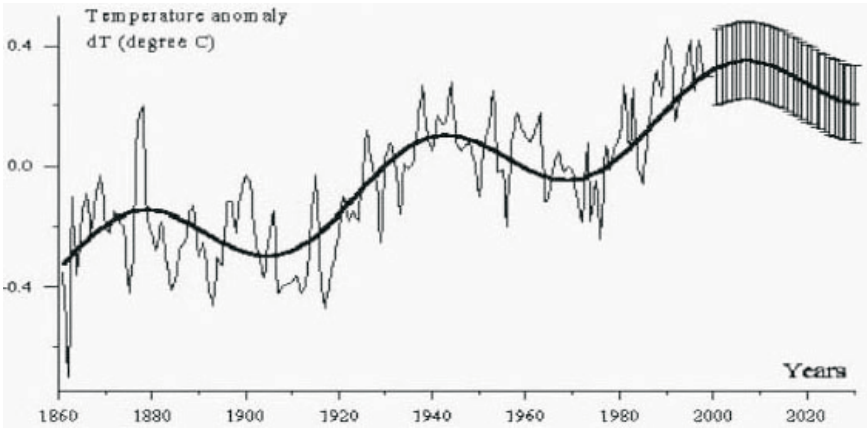

FIG 5 - Instrumentally measured changes in global temperature for 1861 - 2000 (thin line), fitted with a cyclic modelled trend of period 64 years (bold line, with error bars for 2000 - 2030) (after Klyashtorin and Lyubushin, 2003, Figure 5). Projection of climatic cycling into the 21st century indicates a predicted cooling trend.

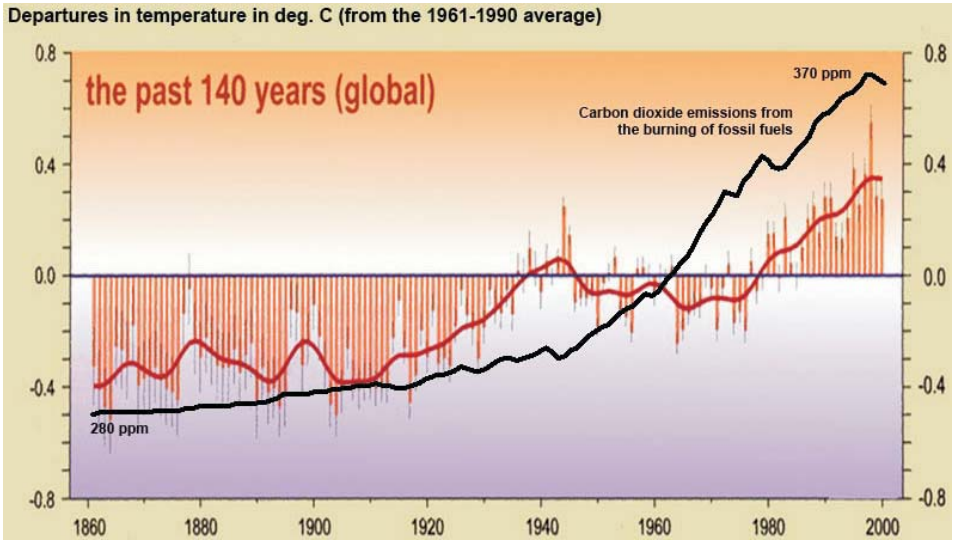

FIG 6 - Combined annual land surface-air and sea surface global temperature anomalies (°C) for 1861 - 2001 relative to a 1961 - 1990-average baseline, and plotted with the estimated two standard error uncertainty (after IPCC, 2001, Figure 2). Also plotted, without error bars, is the estimated curve of atmospheric carbon dioxide values over the same period. Note the lack of correspondence between the two curves, and especially that cooling accompanied the marked increase in carbon dioxide emissions between 1950 and 1970.

average global surface temperature is meaningful and pose the additional question: 'is it possible to establish an accurate estimate of its magnitude?' As Dr Vincent Gray (personal communication) and other climate rationalists have pointed out, even if we accept the IPCC curve as a starting point for discussion, its use as an accurate measure of climate change faces five insuperable difficulties.

First, the temperature measurement sites are located non-randomly, more than 90 per cent being on land despite about 70 per cent of the earth's surface being represented by ocean. Second, over time many of the measurement sites have experienced changes in their surroundings that impact on local temperature (eg new buildings, trees cut down or planted, ageing paint on sun enclosures), introducing a warming bias into the measurements; studies suggest that both urban heat island and rural land-clearing effects have a material influence (Christy *et al*, 2006; Pielke *et al*, in press; Ren *et al*, 2007). As one example, 1881 - 2004 temperature data from Europe reveal a warming rate of 0.67°/century for urban meteorological stations as opposed to 0.37°/century for rural stations (Janssens, 2007). Third, the number of measurement sites used varies dramatically through time, starting in 1850 at 200 sites, building to more than 14 000 in 1965 and then declining to about 5000 by 2000 AD. Fourth, the temperature at each site is constructed using the statistically doubtful historic method of averaging the maximum and minimum temperatures measured once each day at the site. Fifth, and finally, the data used to construct the version of the global surface temperature used by the IPCC is not released to the public; the curve is therefore unreproduceable in the sense that it cannot be checked independently (eg McIntyre, 2007; see also Addendum).

One is forced to the conclusion that – despite their pre-eminence in the public debate, and despite the laborious statistical analysis involved in compiling them – the historic temperature records reconstructed from ground thermometer data are of little value. Changes of less than 1°C/century displayed on such curves may not exceed the true error bars of the average temperature estimates. Therefore, the climate records that are of most value for estimating 20th century climate change in true context are those from high-quality proxies such as sediment cores, ice cores or tree rings. Many such proxies show no untoward warming at the end of the 20th century, and that they usually represent local or regional rather than global climate change is no reason to discount them.

IS GLOBAL AVERAGE TEMPERATURE RISING OR FALLING?

There is no simple answer to this question. Despite the uncertainties just discussed, the global surface thermometer dataset and various high-quality geological proxy temperature datasets are widely used as a basis for climate trend estimates. For any such dataset, the answer to the apparently innocent question posed in the heading depends entirely on the chosen end-points of the data being considered. For instance, using the Greenland ice core oxygen isotope data (proxy for local temperature), warming has taken place since 16 000 years ago, and also since 100 years ago (Davis and Bohling, 2001) (Figure 7). Over intermediate time periods, however, cooling has occurred since 10 000 and 2000 years ago, and temperature stasis characterises both the last 700 years and (globally, from meteorological records) the last eight years. Considering these facts, is the temperature in Greenland warming or cooling?

Both the eight and 100 year-long intervals of temperature change are too short to carry statistical significance regarding long-term climate change. However, though the last 100 years of temperature record has only limited climatic significance (for instance, representing only three climate normal datapoints), it is nonetheless important because it corresponds to the span of instrumental meteorological records from the earth's surface. Accepting the 1860 - 2006 temperature record used by the IPCC (2007; Climate Research Unit, University of East Anglia) as a best measure, we find that there has been no significant increase in surface global temperature since the peak El Nino year of 1998 (Figure 8). This result is confirmed by the two most reliable records of average tropospheric temperature, drawn from weather balloon radiosondes (since 1958) and satellite-mounted microwave sounding units (MSU; since 1979). Of all these datasets, the MSU record is accepted to be the most accurate and globally representative. Once the effects of El Nino warmings and volcanic coolings are allowed for, this record shows no significant warming since its inception in 1979 (Gray, 2006) (Figure 9). This conclusion is robust. Though several other global temperature datasets exist, and though the MSU record has been subject to repeated corrections in interpretation, none of the available datasets document significant recent greenhouse warming.

The global temperature stasis between 1998 and 2006 occurred despite continuing rises in atmospheric carbon dioxide

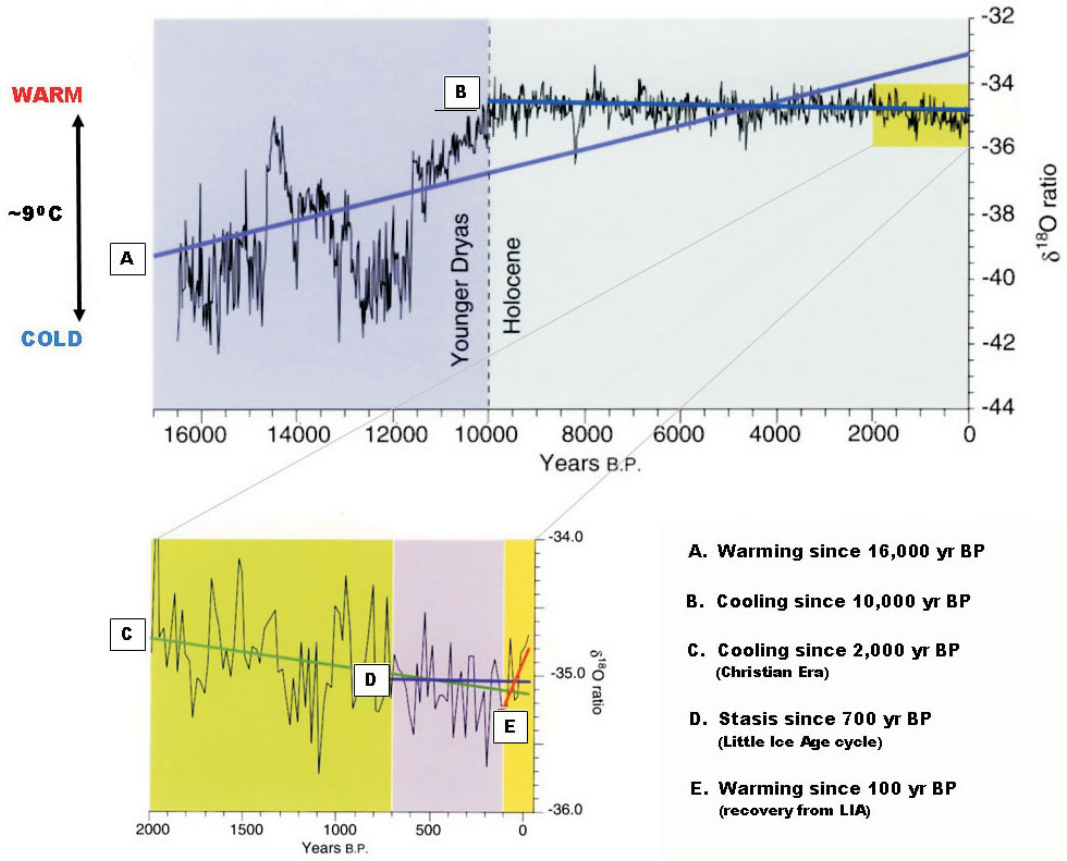

FIG 7 - Climatic cycling over the last 16 000 years as indicated by averaged 20-year oxygen isotope ratios from the GISP2 Greenland ice core (after NSIDC User Services, 1997 and Davis and Bohling, 2001). Trend lines A-E all extend up to the end of the 20th century, fitted through the data for the last 16 000, 10 000, 2000, 700 and 100 years, respectively. The trends are indicative of both warming and cooling, depending upon the chosen starting point, and all except E are statistically significant.

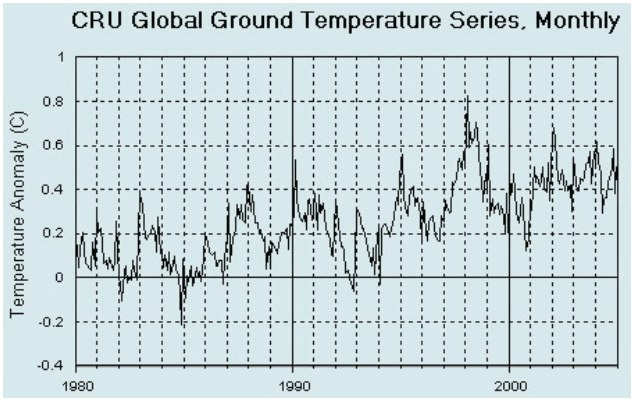

FIG 8 - Combined annual land surface-air and sea surface global temperature anomalies (°C) for 1980 - 2005 relative to a 1961 - 1990-average baseline (data from Climate Research Unit, University of East Anglia). Though a warming of perhaps 0.3°C is recorded between 1980 and 1998 (a marked El Nino year), no warming has occurred in the seven subsequent years despite continued large increases in human-sourced atmospheric carbon dioxide.

over that period. Consistent with this, Karner (2002) showed from an analysis of global temperature series that:

> *... antipersistence in the lower tropospheric temperature increments does not support the science of global warming developed by IPCC.*

> *Negative long-range correlation of increments during the last 22 years means that negative feedback has been dominating in the Earth climate system during the period.*

These facts, and the lack of a discernable human greenhouse effect in late 20th century temperature records, are consistent with Khilyuk and Chilingar's (2006) estimate that the human greenhouse forcing is four to five orders of magnitude less than the major natural forcing agents.

In summary, the slope and magnitude of temperature trends inferred from time-series data depend upon the choice of data end points. Drawing trend lines through highly variable, cyclic temperature data or proxy data is therefore a dubious exercise. Accurate direct measurements of tropospheric global average temperature have only been available since 1979, and they show no evidence for greenhouse warming. Surface thermometer data, though flawed, also show temperature stasis since 1998. This pattern is not what is portrayed in the daily news media.

ARE TEMPERATURES CHANGING AT A DANGEROUS RATE, OR HAVE THEY REACHED A DANGEROUS LEVEL?

Fitting short-term trend lines through temperature or proxy temperature data with no regard to underlying climate cycles is meaningless, but this is widely ignored in the climate change literature. Prestigious science academies and *ad hoc* expert committees deliver reports that say (or imply), first, that meaningful trends can be identified, and, second, that the rates and magnitudes of temperature increase observed are *ipso facto* unusual or dangerous.

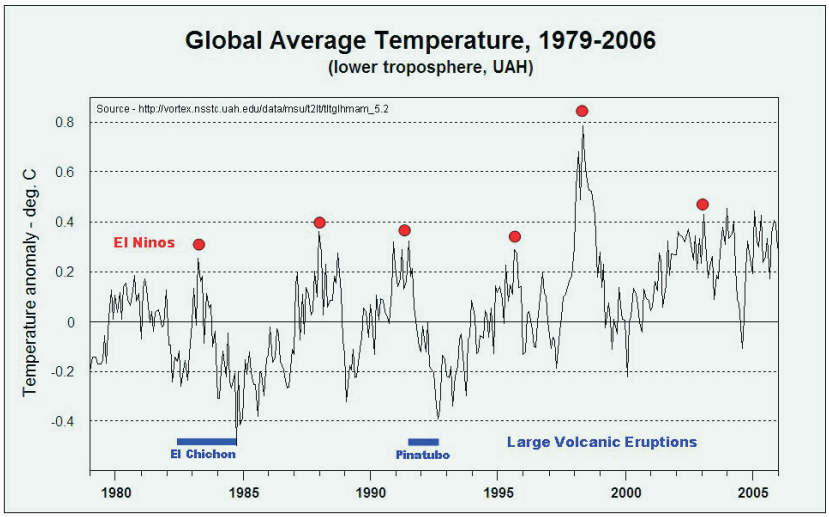

FIG 9 - Lower tropospheric temperature anomaly since 1979 as measured by satellite-mounted microwave sounding units (MSU; from hhttp://vortex.nsstc.uah.edu/data/msu/t2lt/tltglhmam_5.2). When the warming effect of El Ninos, and the cooling effect of the El Chichon and Pinatubo volcanic eruptions, are discounted, little if any greenhouse-forced warming is apparent for the last 25 years (Gray, 2006) Note also that these tropospheric measurements agree with the ground-based thermometer series (Figure 8) in recording no significant warming since 1998, and probably none since 1982.

For example, the US Climate Change Science Program (CCSP, 2006), using all available instrumental data, reported late 20th century rates of temperature increase of 1 - 2°C/century, and IPCC (2007) estimated the overall magnitude of the temperature increase over the last 100 years to be 0.74°C. However, both of these estimates ignore the presence in all climate data of decadal-centennial cyclicity (incidentally, they also ignore the presence in their datasets of clear El Nino and volcanic eruption signals of non-greenhouse origin). Meaningful comparative judgements about climate change cannot be made on the basis of the trivially-short, 150-year-long thermometer surface temperature record, much less on the 27-year-long satellite tropospheric record.

To compare late 20th century warming with earlier geological warm events requires the use of local proxy data, because no global temperature statistics are available prior to the 20th century. One of the best such datasets that extends over an adequate period of time is the oxygen isotope record from the Greenland ice core already referred to (Grootes *et al*, 1993; Davis and Bohling, 2001). These data show a ~1500 year warming-cooling cycle of 1 - 2°C *magnitude*. This cyclicity is probably of solar origin (Bond *et al*, 2001; Singer and Avery, 2006), and the late 20th century warming period represents a peak within it (Figure 10). Consistent with this, Solanki *et al* (2004) have shown that the activity of the sun has been building since the end of the Little Ice Age in the late 19th century, and that over the last 60 years it has been at its strongest since the early Holocene, c. 8000 ybp. In turn, Svensmark (2007, and other papers) has identified a possible mechanism whereby solar activity affects cosmic ray influx which in turn controls the cloud formation that acts as one of the Earth's main thermostats.

The Greenland ice core data also reveal typical *rates* of temperature change of up to 2.5°C/century for periods of cooling and warming of decadal to centennial time span (Figure 11).

In Greenland, then, the late 20th century warming proceeded at unalarming rates to reach a peak that was probably cooler than were the preceding Minoan, Mediaeval and Roman warm periods. And at the other pole, in Antarctica, similar ice core evidence shows that late 20th century temperature was up to 5°C cooler than temperature highs associated with geologically recent interglacial periods (Watanabe *et al*, 2003). Therefore, the magnitude of the late 20th century warming, and its rate of change, both fall well within known natural limits. In addition, the late 20th century warming that is widely attributed to human greenhouse emissions is of similar rate and magnitude to an earlier natural warming between 1905 and 1940; in relationship to which, it has been shown that the warmest decade of the last 1250 years in the European Alps was the 1940s rather than the 1990s (Buntgen *et al*, 2006).

The IPCC's (2001, p 97) prescient diagnosis therefore remains true today:

> *The fact that the global mean temperature has increased since the late 19th century and that other trends have been observed does not necessarily mean that an anthropogenic effect on the climate system has been identified. Climate has always varied on all time-scales, so the observed change may be natural. A more detailed analysis is required to provide evidence of a human impact.*

IS THE IPCC A SCIENTIFIC OR POLITICAL BODY? HOW GOOD IS ITS SCIENTIFIC ADVICE?

The body to which most governments turn for advice on climate change is the IPCC. Formed in 1988 by the United Nations and the World Meteorological Organization, the IPCC has now issued three substantial statements, the First (1990), Second (1995) and Third (2001) Assessment Reports, each of which incorporates the research and opinions of many hundreds of qualified scientists. The reports are detailed and compendious, and each is therefore accompanied by a short chapter termed a Summary for Policymakers (SPM) which is designed for political application. Many distinguished scientists refuse to participate in the IPCC process, and others have resigned from it, because in the end the advice that the panel provides to governments is political and not scientific (Gray, 2002; see also summary at NZ Climate Science Coalition, 2005, Appendix B).

Despite the expenditure of at least $50 billion on climate research since 1990, the science arguments for a dangerous human influence on global warming have, if anything, become weaker since the establishment of the IPCC. Yet the rhetoric of alarm has been successively ramped up, from:

> *the observed (20th century temperature) increase could be largely due to ... natural variability* (IPCC, 1990);

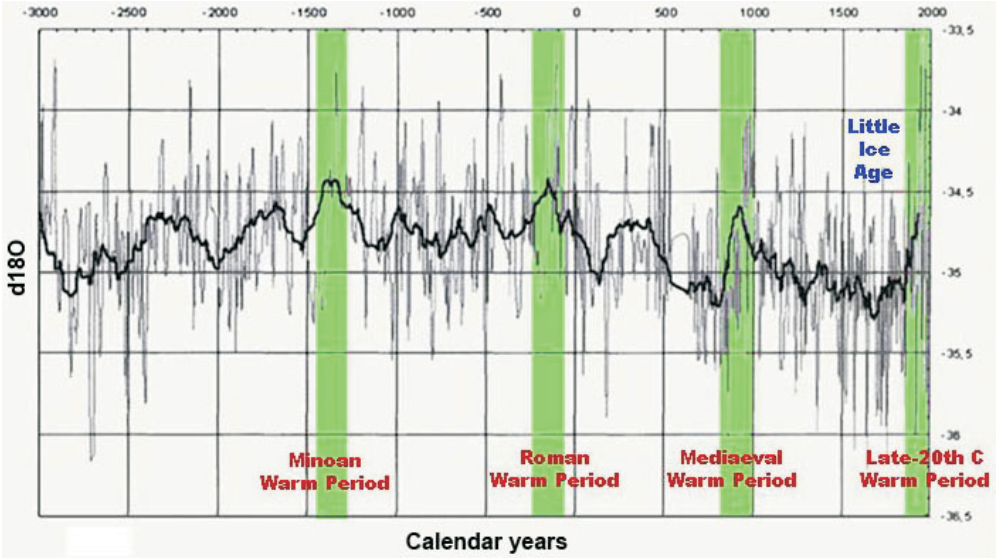

FIG 10 - Oxygen isotope time series for the last 5000 years, GISP2 Greenland ice core (light line; same dataset as Figure 7), fitted with a moving average (dark line; after a slide by Andre Illarianov, 2004). The Late 20th Century Warm Period represents the latest of a regular millennial cycle of similar warm periods (grey stripes). The Late 20th Century Warm Period may have equalled the magnitude of the Mediaeval Warm Period, but it has not yet attained the warmth of either of the preceding Roman or Minoan Warm Periods.

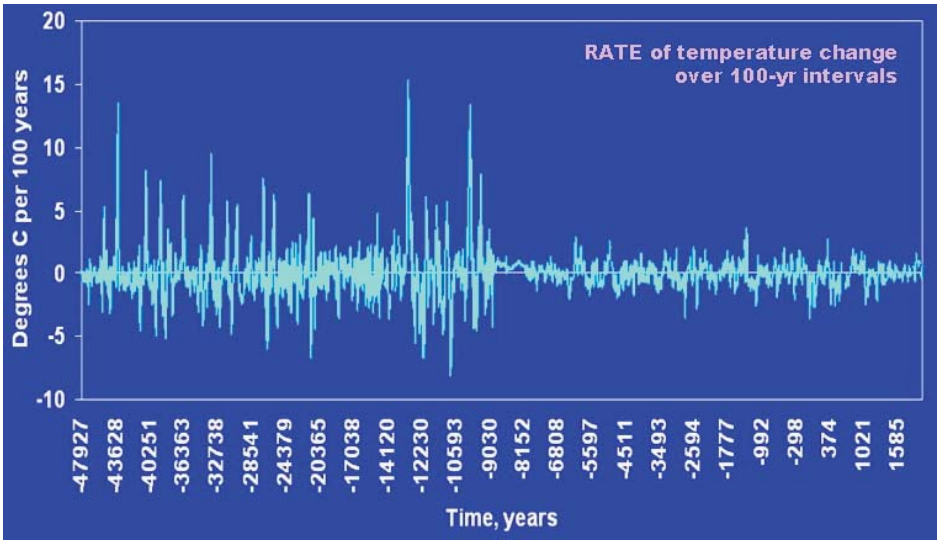

FIG 11 - Rate of temperature change for the last 48 000 years, in °C/century, based on the analysis of oxygen isotope ratios from the GISP2 ice core (same dataset as Figure 7; after a slide by Andre Illarianov, 2004). Note that during the last 9000 years of the Holocene, temperature change occurred regularly at rates between +2.5° and -2.5°C/century. Earlier, during the last glaciation, rates of change as high as 15°C/century are indicated.

> to *the balance of the evidence suggests a discernible human influence on climate* (IPCC, 1995):
>
> to *there is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities* (IPCC, 2001);
>
> to *it is 90 per cent probable* that the recent warming is *due to the observed increase in anthropogenic greenhouse gas concentrations (IPCC, 2007).*

What *can* the evidence be for these increasingly dramatic warnings?

The IPCC advances three main categories of argument for a dangerous human influence on climate. The first is that over the last 100 years global average temperature increased by about 0.74°C, which indeed it did if you accept (against the odds) that the surface thermometer record used by the IPCC is accurate (cf Figure 6). More reliably, historical records and many geological data sets show that warming has indeed occurred since the intense cold periods of the Little Ice Age in the 14th, 17th and 19th centuries (eg Lamb, 1977). The part of this temperature recovery which occurred in the 20th century is the much famed 'global warming', alleged to have been caused by the accumulation of human-sourced carbon dioxide in the atmosphere. However, the high quality MSU satellite data discussed earlier signal not only the absence of substantial human-induced warming by recording similar temperatures in 1980 and 2006 (Figure 9), but also provide an empirical test of the greenhouse hypothesis as understood by the public – a test that the hypothesis fails.

The second category of alarmist argument rests upon circumstantial evidence. It is epitomised by Al Gore's film '*An Inconvenient Truth*', which claims that human greenhouse emissions are causing accelerated melting of icecaps, dangerous increases in the rate of sea-level rise, increases in the frequency and intensity of droughts or catastrophic storms, and enhanced rates of biodiversity loss. Every such circumstantial argument ignores two basic facts. The first is that all environmental phenomena fluctuate in their rate, frequency or intensity as part of the normal workings of our dynamic planet. The second, which follows, is that whether a particular short-term change over, say, the early 21st century has any human causation can only be assessed when all the causes of natural environmental change are fully understood. Many different fields of study are involved and all are the subject of intensive ongoing research. From this research emerges one implacable fact. It is that – despite the weekly promulgation of new alarmist headlines in the media – in no case yet has any climate-sensitive environmental parameter been shown to be changing at a rate that exceeds its historic natural rate of change, let alone in a way that can be unequivocally associated with human causation. For example, despite numerous attempts to link an increase in the intensity or number of hurricanes to late 20th century warming, convincing statistical evidence is absent (Kossin *et al*, 2007). Similarly, the rates of sea-level rise now predicted by the IPCC (IPCC, 2007) is consistent with the expected natural rates of rise that have been documented from tide gauge records over the last 200 years (IPCC, 2001). And similarly again, both the Greenland and Antarctic ice sheets are close to mass balance (Zwally *et al*, 2005), and the interiors of both have cooled over recent decades.

The third line of IPCC argument, and the least convincing of all, is the use of computer calculations to assess the likely future course of climate. Many billions of dollars have been expended by major climate research groups on honing complex GCMs of the ocean and atmosphere. The models are a great intellectual accomplishment, and their application helps us to understand environmental and climatic change in many different ways. However, none of these models has been validated, in the sense of having passed successful prediction tests over the required range of circumstances, and their accuracy is therefore unknown. As Hendrik Tennekes remarked recently, 'a (GCM) prediction fifty or a hundred years into the future is an idle gesture'. That the IPCC relies so heavily upon complex GCM-generated scenarios as the basis for its climate alarmism is in point of fact alarming in its own right; it also reflects the absence of any strong empirical evidence for human-caused climate change, as outlined earlier.

Special pleadings aside, therefore, the evidence for dangerous human-caused global warming forced by human carbon dioxide emissions is extremely weak. That the satellite temperature record shows no substantial warming since 1978, and that even the ground-based thermometer statistic records no warming since 1998, indicates that a key line of circumstantial evidence for human-caused change (the parallel rise in the late 20th century of both atmospheric carbon dioxide and surface temperature) is now negated.

Against this background, in February this year the IPCC released the SPM for its fourth (Science) Assessement Report. The new summary (capriciously released two months before the report to which it refers) does not ameliorate the IPCC's rhetoric. The summary also continues the regrettable practice of allocating arbitrary numerical probability estimates to the causes and risks of future damaging climate change (IPCC, 2005). In the present state of knowledge, no scientist – IPCC acolyte or otherwise – can justify the statement that:

> *most of the observed increase in globally averaged temperature since the mid-20th century is very likely* (= 90 per cent probable) *due to the observed increase in anthropogenic greenhouse gas concentrations* (IPCC, 2007).

CONCLUSIONS

It is plain that the press have failed in their role as public 'watchdog' against the specious pleadings of contemporary climate alarmists; indeed, the media itself is a self-interested party to the debate (cf Carter, 2006a, b). And, returning to our starting point, political leaders such as British Prime Minister Tony Blair are misadvised both by this press bias and also because they have mistakenly trusted the IPCC to provide dispassionate scientific advice about global warming. In reality, with the complete discrediting of the 'hockey stick' curve of recent temperature change (McIntyre and McKitrick, 2003, 2005; Wegman, Scott and Said, 2006) that was the icon of their report, the IPCC case for dangerous human-caused warming now rests only on ambiguous anecdotal evidence, unvalidated computer models and misleading attribution studies (IPCC, 2007). Appearing to concede this, and providing a truly frightening insight into the 'scientific' attitudes of the professional climate science research community, UK Tyndall Centre Director, Professor Mike Hulme, wrote recently in *The Guardian* (14 March, 2007) that:

> *Self-evidently dangerous climate change will not emerge from a normal scientific process of truth seeking, although science will gain some insights into the question if it recognises the socially contingent dimensions of a post-normal science. But to proffer such insights, scientists – and politicians – must trade (normal) truth for influence. If scientists want to remain listened to, to bear influence on policy, they must recognise the social limits of their truth seeking and reveal fully the values and beliefs they bring to their scientific activity.*

Climate change as a natural hazard is as much a geological as it is a meteorological issue. It therefore needs to be managed in the same way as other geohazards, ie by monitoring for the onset of dangerous events and having in place an emergency response plan to deal with any that eventuate. One meritorious example of this is New Zealand's geohazard network, termed GeoNet, which provides civil defense authorities and the public with accurate, evidence-based information regarding hazards such as earthquakes, volcanic eruptions, tsunamis and floods. Though climate change has so far not been included in GeoNet planning, it differs from the hazards that are covered only in the extended decadal time-scale over which a deleterious trend may occur; GeoNet already deals with the short-term extreme weather events that are associated with New Zealand's mid-latitude, maritime location. Climate response plans also need to be able to cope with the type of sudden 'climate' events that are known both in human (1816, the 'year without a summer'; Harington, 1992) and geological history (sharp warmings over a few years to decades, followed by coolings, associated with 1470 year-period Dansgaard-Oeschger events; eg Burns *et al*, 2003).

Those planning national climate policies must abandon the alarmist IPCC view of climate change, and the illusory goal of climate mitigation. Instead, plans are needed to identify when a dangerous weather or climate event is imminent, or has started. At the same time, research spending should be reallocated from greenhouse and computer modelling studies and put towards the study of natural climate rhymns and the development of predictive tools for longer term climatic coolings and warmings. *Natural* climate change being a real and undisputed hazard it is certainly something that governments should prepare for, in the same way that they plan for other natural disasters. Of the two future climate possibilities, dangerous warming or dangerous cooling, the evidence suggests that cooling will be the more damaging; arguably, it is also the most imminent threat. First, because there has been no measurable warming of global average temperatures since 1998; second, because this lack of warming coincides with empirical computer predictions for cooling and

evidence for decreasing solar activity in the first few decades of the 21st century; and third because the current warm interglacial period has already lasted 10 000 years and will inevitably be followed by a glaciation.

Whether human activities have a measurable global influence on natural climate trends has yet to be demonstrated. And, depending upon the balance of the mechanisms (eg aerosols versus greenhouse gases), the overall human effect could in the end turn out to be one of either warming or cooling (cf IPCC, 2007, Figure SPM-2). That we don't yet know which is, of course, a reflection of the small size of the human signal and of the fact that it is deeply buried in the noise of the natural climate system. The current human-caused global warming hysteria – promulgated by the media – is especially dangerous because it is causing governments to neglect the much more real (though long-term) dangers of natural climate change. Even worse, it is causing profound damage to the use of science as an impartial arbiter in public affairs.

This paper started with an alarmist quotation about global warming from British Prime Minister Tony Blair. It seems appropriate to end it, therefore, by recounting the advice that President Vaclav Klaus of the Czech Republic recently (March, 2007) delivered to the US Congress Committee on Energy and Commerce:

> *As someone who lived under communism for most of my life I feel obliged to say that the biggest threat to freedom, democracy, the market economy and prosperity at the beginning of the 21st century is not communism or its various softer variants. Communism* (has been) *replaced by the threat of ambitious environmentalism … The environmentalists consider their ideas and arguments to be an undisputable truth and use sophisticated methods of media manipulation and PR campaigns to exert pressure on policymakers to achieve their goals. Their argumentation is based on the spreading of fear and panic by declaring the future of the world to be under serious threat. In such an atmosphere they continue pushing policymakers to adopt illiberal measures, impose arbitrary limits, regulations, prohibitions, and restrictions on everyday human activities and make people subject to omnipotent bureaucratic decision-making … Man-made climate change has become one of the most dangerous arguments aimed at distorting human efforts and public policies in the whole world.*

ACKNOWLEDGEMENTS

I thank Dr Basil Beamish and Dr Gerrit van der Lingen for providing constructive critical comments on the draft of this paper, Willis Eschenbach for providing the graphs for Figure 4, and the Australian Research Council for financial support under grant DP 0344080. It is also appropriate that I acknowledge the many colleagues who participate in the email chat groups Climate Sceptics (moderated for many years by Timo Hameranta, and now by David Wojick) and New Zealand Climate Science Coalition (moderated by Terry Dunleavy). Chat group members are too numerous to name individually, but I thank them all for the questing, critical and informative nature of their postings on many diverse topics, for it has greatly expanded my knowledge and understanding of the vexed issue of global climate change.

RECOMMENDED WEB SITE LINKS

The following URLs contain much useful discussion and many additional references on the pros and cons of human-caused global warming. Peer-reviewed literature on global warming has for many years been subject to a stifling conformity, whereby views that differ from the IPCC alarmist consensus are suppressed or otherwise discounted. Achieving a balanced view on climate change therefore demands that an interested party seek out the sort of informed but informal discussion that can be found amongst the following links.

- Author's biography: http://members.iinet.net.au/~glrmc/index.htm
- Tom Nelson, critical analysis of the CO_2 warming issue: brneurosci.org/co2.html
- Roger Pielke's blog on climate issues: climatesci.colorado.edu
- US Senator James Inhofe, climate issues: epw.senate.gov/public/index.cfm?FuseAction=Minority.Blogs
- John McLean, analysis and links on climate change: mclean.ch/climate/global_warming.htm
- Bob Carter, analysis and links on climate change: members.iinet.net.au/~glrmc/new_page_1.htm
- Francis Massen, news, analysis and links on climate change: meteo.lcd.lu
- Steve McIntyre, critical analysis of the statistical basis of climate change issues: www.climateaudit.org
- NZ Climate Science Coalition, useful links and documents on climate change: www.climatescience.org.nz
- Analysis and comment on climate-related issues: www.co2andclimate.org/climate
- Sherwood and Keith Idso, critical comment on climate-related issues, especially CO_2: www.co2science.org
- Cooler Heads Coalition, thorough coverage of climate news: www.globalwarming.org/index.php
- Peter Glover, analysis and links on climate change: www.globalwarminghysteria.com
- A US-based international group of climate experts with special strength in meteorology: www.icecap.us
- John Daly (dec), considered contrarian viewpoints on climate change: www.john-daly.com
- Lavoisier Group, discussion and useful links on greenhouse issues: www.lavoisier.com.au
- National Resources Stewardship Project, links on climate change issues: www.nrsp.com/news.html
- PAGES, up-to-date data on ancient climate change: www.pages.unibe.ch/cgi-bin/WebObjects/products.woa
- Ross McKitrick, critical analysis of the 'hockey-stick' graph: www.uoguelph.ca/~rmckitri/research/trc.html
- Warwick Hughes, critical analysis of IPCC and other climate change science: www.warwickhughes.com
- Doug Hoyt, critical analyses of climate change science: www.warwickhughes.com/hoyt/climate-change.htm
- Pat Michaels blog on climate issues: http://www.worldclimatereport.com

REFERENCES

Abdussamatov, H I, 2004. On long-term variations of the total irradiance and decrease of global temperature of the Earth after a miximum of xxiv cycle of activity and irradiance, *Bulletin of Crimea Observatory*, 103:122-127.

Bashkirtsev, V S and Mashnich, G P, 2003. Will we face global warming in the nearest future? *Geomagnetism i Aeronomia*, 43:124-127.

Beck, E-G, 2007. 180 years of CO_2 gas analysis by chemical methods, *Energy and Environment*: in review.

Bond, G, Kromer, B, Beer, J, Muscheler, R, Evans, M N, Showers, W, Hoffmann, S, Lotti-Bond, R, Hajdas, I and Bonani, G, 2001. Persistent solar influence on North Atlantic climate during the Holocene, *Science,* 294:2130-2136.

Boucot, A J, Xu, C and Scotese, C R, 2004. Phanerozoic climate zones and paleogeography with consideration of atmospheric CO2 levels, *Paleontologicheskiy Zhurnal,* 2:3-11.

Buntgen, U, Frank, D C, Nievergelt, D and Esper, J, 2006. Summer temperature variations in the European Alps, AD 755 - 2004, *Journal of Climate*, 19:5606-5623.

Burns, S J, Fleitmann, D, Matter, A, Kramers, J and Al-Subbary, A A, 2003. Indian Ocean climate and an absolute chronology over Dansgaard/Oeschger Events 9 to 13, *Science*, 301:1365-1367.

Caillon, N, Severinghaus, J P, Jouzel, J, Barnola, J M, Kang, J and Lipenkov, V Y, 2003. Timing of atmospheric CO_2 and Antarctic temperature changes across Termination III, *Science*, 299:1728-1731.

Carter, R M, 2006a. Public misperceptions of human-caused climate change: The role of the media, Testimony before the US Senate Committee on Environment and Public Works, December 6, 2006 [online]. Available from: <http://members.iinet.net.au/~glrmc/new_page_1.htm>.

Carter, R M, 2006b. Human-caused global warming. McCarthyism, intimidation, press bias, censorship, policy-advice corruption and propaganda, Tabled paper before the US Senate Committee on Environment and Public Works, 6 December 2006 [online]. Available from: <http://members.iinet.net.au/~glrmc/new_page_1.htm>.

Carter, R M, de Freitas, C R, Goklany, I M, Holland, D and Lindzen, R S, 2006. The Stern Review: A dual critique, Part I: The Science, *World Economics*, 7:167-198.

CCSP, 2006. Temperature Trends in the Lower Atmosphere: Steps for Understanding and Reconciling Differences (ed: T R Karl, S J Hassol, C D Miller and W L Murray), A Report by the Climate Change Science Program and the Subcommittee on Global Change Research, Washington, DC.

Christy, J R, Norris, W B, Redmond, K and Gallo, K P, 2006. Methodology and results of calculating central California surface temperature trends: Evidence of human-induced climate change? *Journal of Climate*, 19:548-563.

Chumakov, N M, 2004. Trends in global climate changes inferred from geological data, *Stratigraphy and Geological Correlation*, 12:117-138.

Davis, J C and Bohling, G C, 2001. The search for patterns in ice-core temperature curves, in *Geological Perspectives of Global Climate Change* (ed: L C Gerhard *et al*), *American Association of Petroleum Geologists, Studies in Geology,* 47:213-229.

de Freitas, C R, 2002. Are observed changes in the concentration of carbon dioxide in the atmosphere really dangerous? *Bulletin of Canadian Petroleum Geology*, 50:297-327.

Ditlevsen, P, 2007. Climate Change: Could It Be Random? [online]. Available from: <http://www.sciencedaily.com/releases/2007/03/070309103123.htm>.

Eamus, D, 1996. Responses of field grown trees to CO_2 enrichment, *Commonwealth Forestry Review*, 75:39-47.

Essex, C and McKitrick, R, 2002. *Taken by Storm. The Troubled Science, Policy and Politics of Global Warming,* Key Porter paperback.

Essex, C, McKitrick, R and Andresen, B, in press. Does a global temperature exist? *Journal of Non-Equilibrium Thermodynamics.*

Fischer, H, Wahlen, M, Smith, J, Mastroianni, D and Deck, B, 1999. Ice core records of atmospheric CO_2 in the past two centuries, *Science*, 283:1712-1714.

GeoNet, 2006. The GeoNet Project. Monitoring geological hazards in New Zealand [online]. Available from: <http://www.geonet.org.nz/>.

Gerhard, L E, Harrison, W E and Hanson, B M, 2001. Geological perspectives on climate change, *American Association of Petroleum Geologists, Studies in Geology*, 47:1-372.

Gray, V, 2002. *The Greenhouse Delusion. A critique of 'Climate Change 2001',* 95 p (Multi-Science Publishing Co Ltd: Essex).

Gray, V, 2006. Temperature trends in the lower atmosphere, *Energy and Environment,* 17:707-714.

Gray, W M, 2006. Hurricanes and climate change: Assessing the linkages following the 2006 season, Submission to US Senate Committee on Public Works and Environment, 11 October 2006 [online]. Available from: <http://www.marshall.org/article.php?id=465>.

Grootes, P M, Stuiver, M, White, J W C, Johnsen, S and Jouzel, J, 1993. Comparison of oxygen isotope records from the GISP2 and GRIP Greenland ice cores, *Nature*, 366:552-554.

Harington, C R (ed), 1992. *The Year Without a Summer? World Climate in 1816*, 576 p (Canadian Museum of Nature: Ottawa).

Hulme, M, Jenkins, G J, Lu, X, Turnpenny, J R, Mitchell, T D, Jones, R G, Lowe, J, Murphy, J M, Hassell, D, Boorman, P, McDonald, R and Hill, S, 2002. *Climate Change Scenarios for the United Kingdom: The UKCIP02 Scientific Report*, 120 p, Tyndall Centre for Climate Change Research, School of Environmental Sciences, University of East Anglia, Norwich, UK.

Hurd, B, 2006. Analyses of CO_2 and other atmospheric gases, *Australasian Insitute of Geologists, News*, 86:10-11.

Idso, S B, 2001. Carbon-dioxide-induced global warming: A skeptic's view of potential climate change, in *Geological Perspectives on Climate Change* (eds: L E Gerhard *et al*), *American Association of Petroleum Geologists, Studies in Geology*, 47:317-336.

Indermuhle, A, Monnin, E, Stauffer, B and Stocker, T F, 2000. Atmospheric CO_2 concentration from 60 to 20 kyr BP from the Taylor Dome ice core, Antarctica, *Geophysical Research Letters*, 27:735-738.

IPCC, 1990. *Climate Change – The IPCC Scientific Assessment*, Intergovernmental Panel on Climate Change, Working Group 3, first assessment report (ed: J T Houghton *et al*) (Cambridge University Press: Cambridge).

IPCC, 1995. *Climate Change*, Intergovernmental Panel on Climate Change, Working Group 3, second assessment report (ed: J T Houghton *et al*) (Cambridge University Press: Cambridge).

IPCC, 2001. *Climate Change 2001: The Scientific Basis,* Intergovernmental Panel on Climate Change, Working Group 3, third assessment report (ed: J T Houghton *et al*), 881 p (Cambridge University Press: Cambridge).

IPCC, 2005. Guidance notes for lead authors of the IPCC fourth assessment report on addressing uncertainties [online]. Available from: http://www.ipcc.ch/activity/uncertaintyguidancenote.pdf

IPCC, 2007. *Climate Change: The Physical Science Basis. Summary for Policymakers,* Intergovernmental Panel on Climatic Change, fourth assessment report, Geneva, Switzerland.

Janssens, J, 2007. Climate evolution in Europe (1881 - 2004) [online]. Available from: <http://members.chello.be/j.janssens/Engaarde.html#Europe>.

Jaworowski, Z, 2007. CO_2: The greatest scientific scandal of our time, *Executive Intelligence Review*, 34(11):38-53.

Jones, P D, Groisman, P Y, Coughlan, M, Plummer, N, Wang, W C and Karl, T R, 1990. Assessment of urdanization effects in time series of surface air temperature over land, *Nature*, 347:169-172.

Karner, O, 2002. On non-stationarity and anti-persistency in global temperature series, *Journal of Geophysical Research*, 107:D20.

Khandekar, M L, 2004. Are climate model projections reliable enough for climate policy? *Energy and Environment*, 15:521-525.

Khandekar, M L, Murty, T S and Chittibabu, P, 2005. The global warming debate: A review of the state of science, *Pure and Applied Geophysics*, 162:1557-1586.

Khilyuk, L F and Chilingar, G V, 2006. On global forces of nature driving the Earth's climate. Are humans involved? *Environmental Geology*, 50:899-910.

Kininmonth, W, 2004. *Climate Change: A Natural Hazard* (Multi-Science Publishing: Essex).

Klyashtorin, L B and Lyubushin, A A, 2003. On the coherence between dynamics of the world fuel consumption and global temperature anomaly, *Energy and Environment*, 14:733-782.

Kossin, J P, Knapp, K R, Vimont, D J, Murnane, R J and Harper, B A, 2007. A globally consistent reanalysis of hurricane variability and trends, *Geophysical Research Letters*, 34:L4815, doi: 10.1029/2006GLO028836.

Kotov, S R, 2001. Near-term climate prediction using ice-core data from Greenland, in *Geological Perspectives of Global Climate Change* (eds: L C Gerhard *et al*), *American Association of Petroleum Geologists, Studies in Geology*, 47:305-315.

Kouwenberg, L, Wagner, R, Kurschner, W and Visscher H, 2005. Atmospheric CO_2 fluctuations during the last millenium reconstructed by stomatal frequency analysis of *Tsuga heterophylla* needles, *Geology*, 33:33-36.

Kuo, C, Lindberg, C and Thomson, D J, 1990. Coherence established between atmospheric carbon dioxide and global temperature, *Nature*, 343:709-713.

Kurschner, W M, van der Burgh, J, Visscher, H and Dilcher, D L, 1996. Oak leaves as biosensors of late Neogene and early Pleistocene paleoatmospheric CO_2 concentrations, *Marine Micropalaeontology*, 27:299-312.

Lamb, H H, 1977. *Climate: Present, Past and Future,* vol 2, 835 p (Methuen: London).

Lindzen, R, 2006. Understanding common climate claims, in *Proceedings International Seminar on Nuclear War and Planetary Emergencies* (World Federation of Scientists), Preprint available from: <http://www.climatescience.org.nz/assets/20060507_O_Lindzen.pdf>.

Loehle, C, 2004. Climate change: detection and attribution of trends from long-term geologic data, *Ecological Modelling*, 171:433-450.

Lowenstein, T K and Demicco, R V, 2006. Elevated Eocene atmospheric CO_2 and its subsequent decline, *Science,* 313:1928.

McIntyre, S, 2007. Jones and the Russian UHI [online]. Available from: <http://www.climateaudit.org/?p=664>.

McIntyre, S and McKitrick, R, 2003. Corrections to the Mann *et al* (1998) proxy database and northern hemispheric average temperature series, *Energy and Environment*, 14:751-771.

McIntyre, S and McKitrick, R, 2005. Hockey sticks, principal components, and spurious significance, *Geophysical Research Letters* 32:doi 10.1029/2004GL021750, 5 p.

Mudelsee, M, 2001. The phase relations among atmospheric CO_2 content, temperature and global ice volume over the past 420 ka, *Quaternary Science Reviews* 20:583-589.

New Zealand Climate Science Coalition, 2006. Response of the New Zealand Climate Science Coalition to comments by Dr David Wratt. Attachment B: Inadequacies and criticisms of the Intergovernmental Panel on Climate Change [online]. Available from: <http://www.climatescience.org.nz/assets/20069302011100.ResponseToRSNZ.pdf>.

NSIDC User Services, 1997. *The Greenland Summit Ice Cores*, CD-ROM, GISP-2/GRIP, World Data Center A for Glaciology, CIRES, University of Colorado, Boulder.

Petit, J R, Jouzel, J, Raynaud, D, Barkov, N I, Barnola, J-M, Basile, I, Bender, M, Chappellaz, J, Davis, M, Delaygue, G, Delmotte, M, Kotlyakov, V M, Legrand, M, Lipenkov, V Y, Lorius, C, PÉpin, L, Ritz, C, Saltzman, E and Stievenard, M, 1999. Climate and atmospheric history of the past 420 000 years from the Vostok ice core, Antarctica, *Nature*, 399:429-436.

Philander, S G, 1998. *Is the Temperature Rising - The Uncertain Science of Global Warming*, 262 p (Princeton University Press).

Pielke, R A, Davey, C, Niyogi, D, Fall, S, Steinweg-Woods, J, Hubbard, K, Lin, X, Cai, M, Lim, Y-K, Li, H, Nielsen-Gammon, J, Gallo, K, Hale, R, Angel, J, Mahmood, R, Foster, S, Boyles, R, McNider, R T and Blanken, P, in press. Unresolved issues with the assessment of multi-decadal global land surface temperature trends, *Journal of Geophysical Research*.

Ren, G Y, Chu, Z Y, Chen, Z H and Ren, Y Y, 2007. Implications of temporal change in urban heat island intensity observed at Beijing and Wuhan stations, *Geophysical Research Letters*, 34:L05711, doi:10.1029/2006GL027927.

Robinson, A R, Baliunas, S L, Soon, W and Robinson, Z W, 1998. Environmental effects of increased atmospheric carbon dioxide [online]. Available from: <http://www.oism.org/pproject/s33p36.htm>.

Ruddiman, W F, 2001. *Earth's Climate, Past and Future*, 465 p (Freeman and Company: New York).

Saxe, H, Ellsworth, D S and Heath, J, 1998. Tree and forest functioning in an enriched CO_2 atmosphere, *New Phytologist*, 139:395-436.

Singer, F S and Avery, T A, 2006. *Unstoppable Global Warming: Every 1,500 Years*, 276 p (Rowman & Littlefield Publishers).

Solanki, S K, Usoskin, I G, Kromer, B, Schussler, M and Beer, J, 2004. Unusual activity of the Sun during recent decades compared to the previous 11,000 years, *Nature*, 431:1084-1087.

Stainforth, D A, Aina, T, Christensen, C, Collins, M, Faull, N, Frame, D J, Kettleborough, J A, Knight, S, Martin, A, Murphy, J M, Piani, C, Sexton, D, Smith, L A, Spicer, R A, Thorpe, A J and Allen, M R, 2005. Uncertainty in predictions of the climate response to rising levels of greenhouse gases, *Nature*, 433:403-406.

Stott, P A, Tett, S F B, Jones, G S, Allen, M R, Ingram, W J and Mitchell, J F B, 2001. Attribution of twentieth century temperature change to natural and anthropogenic causes, *Journal of Climate*, 13:513-537.

Svensmark, H, 2007. Cosmoclimatology: A new theory emerges, *Astronomy and Geophysics*, 48:1-18.

Wagner, T, Aaby, B and Visscher, H, 2002. Rapid atmospheric CO_2 changes associated with the 8,200-years-BP cooling event, *Proceedings of the National Academy of Sciences*, 99:12011-12014.

Wasdell, D, 2007. Political corruption of the IPPC Report? [online]. Available from: <http://www.meridian.org.uk/Resources/Global%20Dynamics/IPCC/index.htm>.

Watanabe, O, Jouzel, J, Johnsen, S, Parrenin, F, Shoji, H and Yoshida, N, 2003. Homogeneous climate variability across East Antarctica over the past three glacial cycles, *Nature*, 422:509-512.

Wegman, E J, Scott, D W and Said, Y H, 2006. Ad hoc committee report on the 'Hockey Stick' global climate reconstruction [online]. Available from: <http://republicans.energycommerce.house.gov/108/home/07142006_Wegman_Report.pdf>.

Zhen-Shan, L and Xian, S, 2007. Multi-scale analysis of global temperature changes and trends of a drop in temperature in the next 20 years, *Meteorology and Atmospheric Physics*, 95:115-121.

Zwally, H J, Giovinetto, M B, Li, J, Cornejo, H G, Beckley, M A, Brenner, A C, Saba, J L and Yi, D, 2005. Mass changes of the Greenland and Antarctic ice sheets and shelves and contributions to sea-level rise, *Journal of Glaciology*, 51:509-527.

ADDENDUM

US Supreme Court Decision

On 2 April, the US Supreme Court handed down its decision on the case between the State of Massachusetts and the Environmental Protection Agency (EPA). By a narrow five to four decision, the court ruled that the EPA must consider greenhouse gases as pollutants, saying:

> *Because greenhouse gases fit well within the Clean Air Act's capacious definition of 'air pollutant' we hold that EPA has the statutory authority to regulate the emission of such gases from new motor vehicles.*

The Court also said that the:

> *harms associated with climate change are serious and well-recognized* and that *EPA has offered no reasoned explanation for its refusal to decide whether greenhouse gases cause or contribute to climate change.*

Predictably, the decision was greeted with approval by environmental groups, and with dismay by those who question whether any court has the competence to determine a scientific, rather than a legal, matter. In a dissenting statement, Chief Justice John Roberts said the court lacked constitutional power to second-guess the EPA at the behest of states and environmental groups, adding that the majority's reasoning:

> *has caused us to transgress the proper – and properly limited – role of the courts in a democratic society.*

Justice Antonin Scalia, dissenting also, said the court:

> *has no business substituting its own desired outcome for the reasoned judgment of the responsible agency.*

Refer to http://www.supremecourtus.gov/opinions/06pdf/05-1120.pdf for further information.

Release of data by the Climate Research Unit

Canadian Steven McIntyre is one of several persons who have requested temperature data from the Climate Research Unit at the University of East Anglia, and in particular the data used in a classic study of the urban heat island effect by Jones *et al* (1990).

This request, like other similar requests, was initially refused. After appealing the decision, McIntyre recently received a letter from the Information Policy Officer at the University of East Anglia stating that the data and metadata that can still be identified for this study will be posted for public access on the University's web site no later than 13 April 2007.

Noting the success of McIntyre's statistical challenges to the validity of the Mann *et al*, hockey stick curve, his re-analysis of the Jones *et al* (1990) urban heat island dataset will be of great public interest.

Refer to http://www.climateaudit.org/?p=1323#more-1323 for further information.