

Perspectives on global warming science

C R de Freitas

School of Geography, Geology and Environmental Science
The University of Auckland

AEF Conference
Melbourne, 8-9 September 2007

The global warming issue is as emotionally charged as it is widely misunderstood. Calls for action have put enormous pressure on governments to formulate policies in response to the perceived threat of the human-caused climate change resulting from a build up of greenhouse gases in the atmosphere. The Kyoto Protocol proposed by the United Nations in 1997 calls for OECD countries and former USSR to cut greenhouse gas emissions by 5% from 1990 levels by the year 2012. Despite the political momentum this has generated, there is widespread reluctance to sign on to an international treaty. The main problem is that emission rates are increasing and, given current trends, would be up to 20–30% higher than 1990 levels by 2012. Thus, to meet the requirements of the Kyoto Protocol, many of the industrialized nations of the world must give up one third of their energy use, or find some other way of meeting their commitment. A decrease of this magnitude can only be achieved by severe rationing of oil, coal and natural gas. Because the economic would be immense, the question arises as to whether these harsh measures are justifiable.

Drivers of global warming fears

Confusion about the global warming science is another reason why progress towards ratifying an international agreement has been slow. This is caused by uncertainty surrounding the science of global warming on the one hand, and public perception of the state of this scientific knowledge on the other. This confusion underlies problems confronting decision makers on how and when to act on greenhouse warming.

Despite this confusion, or perhaps because it, global warming catastrophism has acquired a life of its own. It is likely the result of a combination of a number of things. First, it fits well with the popular concern for the environment and widespread zeal for environmentalism. The media prefer worse case scenarios, and no matter how outrageous the tale, it becomes the truth if it is told often enough. The view that global warming is both real and dangerous is now deeply entrenched in the minds of the public. Many are reluctant to challenge this, as it is politically incorrect to do so. It would be taken to imply a lack a concern for the environment. Second, politicians are drawn to the topic of global warming by the appeal of tackling something grand — a global environmental issue, as opposed to merely a local one. There is also the allure of the green vote. Believing in global warming is a litmus test for being environmentally conscientious and hence ethically and politically correct. Third, scientists are in effect reinforcing the view by alarmist speculation to propel public concern about possible dangers of man-made climate change. Heightened concern improves chances of high priority being given to climate change research and ensures an ongoing supply of research funds. Fourth, the issue is confused with the separate matter of conservation of fossil fuels and air quality. The fifth reason is perhaps the most important as it underpins all the others. It is the disproportionate influence of the reports of the United Nations Intergovernmental Panel on Climate Change (IPCC).

At first I along with many others accepted that increases in human caused additions of carbon dioxide and methane in the atmosphere would trigger changes in water vapour and lead to dangerous climate change. But with time and with the results of research, I formed the view that, although it makes for a good story, it is unlikely that the man-made changes are drivers of significant climate variation. I accept there may be small changes. But I see the risk of anything serious to be minute.

Violent weather and worst case scenarios are scary, easily dramatised and thus captivating. But when exaggerated and distorted information is presented to the public as factual and as a basis for public policy, the issue of social responsibility arises.

One could reasonably argue that lack of evidence is not a good reason for complacency. But the billions of dollars committed to global warming research and lobbying for Kyoto-like treaties, a reductions in food miles etc could be better spent on uncontroversial and very real environmental problems (such as air pollution, poor sanitation and clean water availability and inadequate health services in developing countries) that we know affect tens of millions of people.

Much is made of the increase in emissions into the atmosphere over the past 50 years. What is rarely mentioned is that carbon dioxide's effect on global temperature is already close to its maximum, so adding more has an ever decreasing effect. This means that it is unlikely that higher concentrations of carbon dioxide in the atmosphere will greatly influence the climate. To illustrate the process, compare painting over a glass window with thin paint. The first coat of paint cuts out some light, the second coat some more, but beyond this, additional coats have a decreasing effect on light shining through. Figure 1 shows the effect based on well understood atmospheric physics. Assuming a doubling carbon dioxide concentration in the atmosphere from pre-industrial levels (285 to 570 ppm) and assuming everything else remains constant, there would be a 1.5 °C increase in global temperature. This does not take into the effects of feedback, such as the role of clouds and the oceans. But there is no evidence that positive feedbacks drive further change, or that there is high global climate sensitivity to an increase of in carbon dioxide concentration in the atmosphere above present levels. As one such empirical test, it can be noted too that no global increase in temperature has now occurred since 1998 despite an increase in carbon dioxide concentration over the same eight years of about four percent.

For significant global warming to occur, increased concentrations of carbon dioxide must set in motion positive (or destabilising) feedback processes. Such processes would cause temperatures to rise by some other mechanism (such as increased absorption of solar energy) or cause increases in the concentration of other greenhouse gases, the most important of which is, by far, water vapour. Yet to date, scientific evidence suggests that negative (or stabilising) feedback processes prevail (Karner, 2002) and explains why over hundreds of millions of years Earth's climate has never experience runaway warming. It is curious that this fact it is often missed, paradoxically by those attempting to prove that carbon dioxide is a major driver of global climate. For example the Antarctic ice cores used by in the work of A. Gore and other to show this, careful examination reveals the opposite (Figure 2).

Atmospheric carbon dioxide concentration and mean global temperature correlate and cohere such that the carbon dioxide follows the temperature (both up and down) by some months. This was first observed by Kuo et al. (1990) who did a frequency analysis for the period 1950 to 1990, and has been confirmed by other workers using different data sets (Priem, 1997; Dettinger and Ghil, 1998; Fischer et al., 1999, Indermuhle at al., 1999).

In other work, re-analysis of the famous Vostok and Dome ice core shows CO₂ increases lagging about 600 years behind the temperature increases of the three significant deglaciations (Fischer et al, 1999). Clearly, high carbon dioxide levels are not the primary cause of temperature rises signaling the end of an ice age. Higher resolution work of Severinghaus and Brook (1999) also shows that in the deglaciation period temperature rose hundreds of years before concentrations of carbon dioxide followed. This is not consistent with carbon dioxide causing the change in temperature. Other research on geological timescales also shows that sometimes temperatures were high when carbon dioxide concentrations were low, and vice versa (Indermühle et al., 1999, Panagi et al., 1999; Flower, 1999). Significantly, the Antarctic ice cores also show that the preceding four interglacials were warmer than now, yet exhibit lower levels of carbon dioxide.

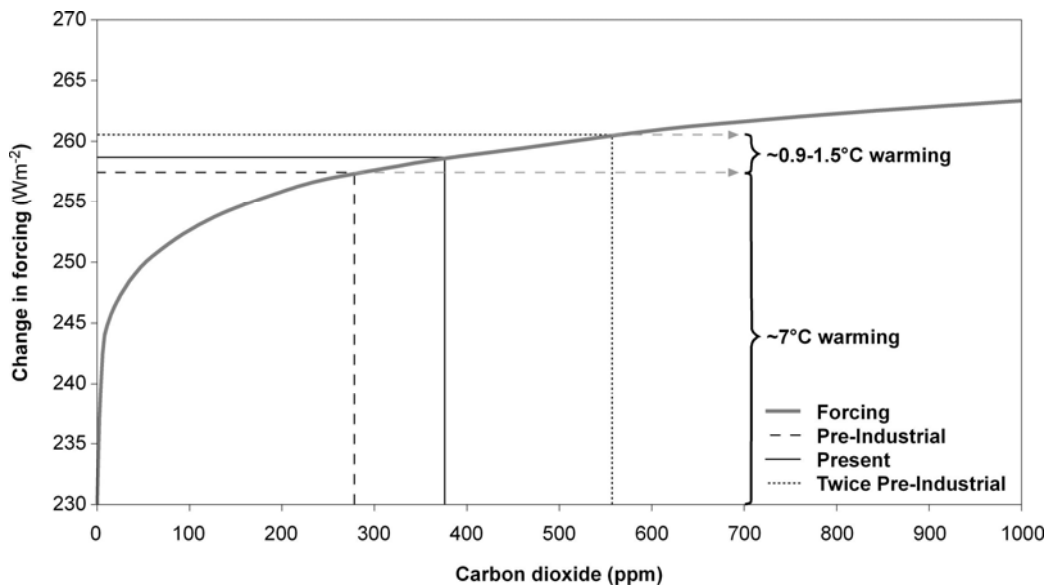


Figure 1. Contribution of changing carbon dioxide concentration (pre-industrial, present and twice pre-industrial) to the greenhouse effect (greenhouse gas radiative forcing) assuming everything else is constant. Adapted from Eschenbach, 2006, using University of Chicago Modtran.

The recent climate record

It is often assumed that climate is constant, and any change must be due to human actions. The data in Figure 2 show clearly this is not so. The recent proxy climate record shows the same thing. During the Medieval Warm Period, from 900 to 1200 AD, the Vikings sailed in Arctic waters that by 1700 had turned to permanent sea ice, and farmed in Greenland soil that soon became too cold for agriculture. The Medieval Warm Period was followed by the Little Ice Age which ended around 1850 (Figure 3). It in turn was followed by another warm period. The causes of these warmings and coolings are unclear.

The IPCC rely on air temperatures measured at the Earth's surface to reconstruct variations in the Earth's annual mean temperature over the past century. The data come from weather stations unevenly distributed over the earth's surface, mainly on land, close to towns and cities. These data show a warming in the range 0.3–0.6 °C over the past century. The question is whether all or part of this warming can be linked to increases in greenhouse gases or to other factors linked to climate variability and change. For example, the warming may simply reflect the additional heat associated with the growth of towns and cities, or from solar variability.

The science of climate change depends entirely on reliable data, quality controlled and homogenized rigorously, to validate numerical simulation models and to identify fluctuations and trends. Until recently, measurements of global air temperature change were based entirely on measurements taken on the ground. Modification of the surface by human activity can have a significant effect on climate near the ground. The best-documented example is the “urban heat island” effect, in which data from urban stations can be influenced by localized warming due to asphalt and concrete replacing grass and trees (Figure 4). This can account for an urban area being as much as 14°C warmer than its rural surroundings. The trends in Figure 5 for Phoenix, Arizona, also illustrate the close correlation of city population size with urban heating influence on air temperature.

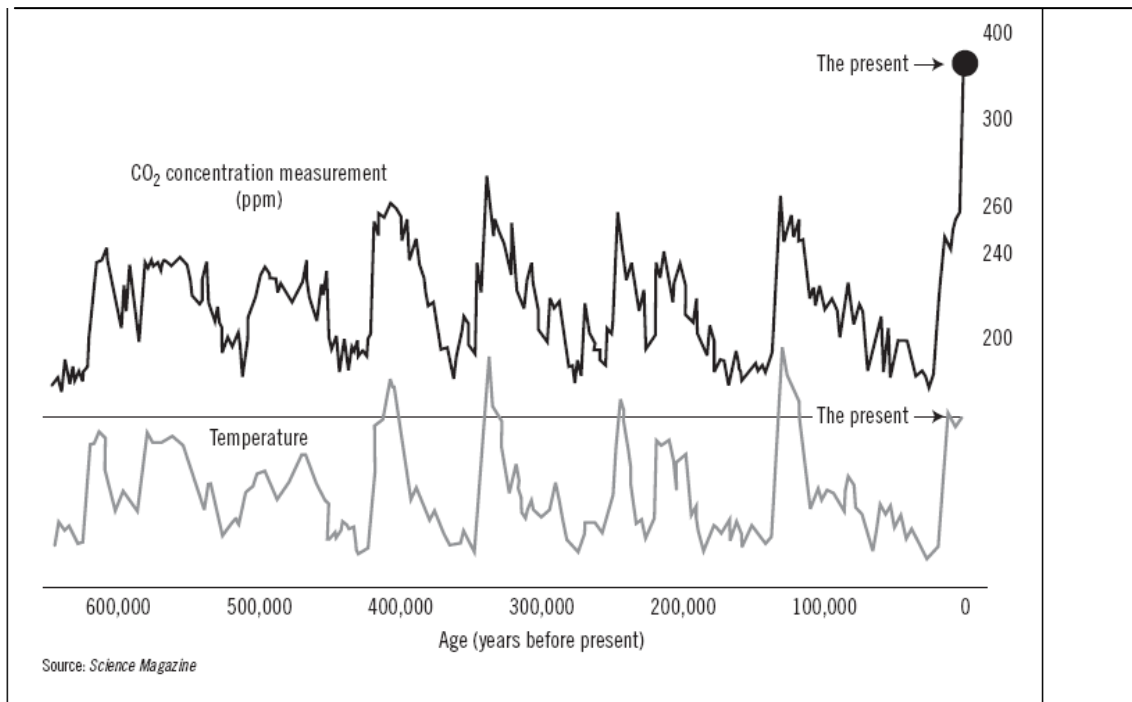


Figure 2. Atmospheric carbon dioxide levels and temperature inferred from Antarctic ice core used in Al Gore’s *An Inconvenient Truth* (2006). Close observation shows that a rise in temperature precedes carbon dioxide by about 500-800 years. The figure also shows that the preceding four interglacials were warmer than now, yet exhibit lower levels of carbon dioxide. This indicates that atmospheric carbon dioxide concentration above current levels is not a major driver of global climate. From Carter et al, 2007.

The IPCC claim that the land-based, surface temperature record it uses is a “de-urbanised” record, but it has been discovered that there is more contamination of the surface temperature record than many climatologists realised (Hansen et al., 1999; Hansen et al., 2001). Hansen et al. (2001, p.23, 962) comment on NASA’s official GISS data: “We find evidence of local human effects (urban warming) even in suburban and small town surface air temperature records.” Moreover, rural stations account for only 7% of the Earth’s area (Peterson et al., 1999). Balling and Idso (1989) have demonstrated that only very small changes in population are enough to induce a statistically significant local warming.

The fact that satellite and weather balloon measurements of the lower troposphere show little warming for the past 23 years strongly suggests that the surface data are

influenced by proximity to human habitation. Evidence of this is reflected in the fact that many remote weather stations do not show a warming. Where warming occurs it results from a rise in the minimum temperature rather than the maximum, and in cold climates, in winter, and at night, which is consistent with so called “urbanization” effects. Many weather stations are located at airports, which originally were located in rural areas on the outskirts of urban areas. But with rapid population growth airports have made a transition from “rural” to “heat island”, and the national agencies responsible for archiving climate data do not take any precautions against these influences. The problem has been made worse by the fact that two thirds of the weather stations operating in 1975, mainly rural, have been closed down.

It is interesting that most good quality non-urban surface records show little or no warming and therefore agree with the satellite data, which began in 1979, and the longer term tropospheric temperatures from balloon-based (radiosonde) instrumentation since 1958. Close inspection of this data shows there has been little if any warming since 1958 (Figure 6), if the step-like “1976 Pacific Climate Shift” is taken into account Guilderson and Schrag, 1998). The shift is caused by a sudden change in ocean circulation and is unrelated to climate causes. This step-like change ocean temperature (Figure 7) correlates with a similar change in the temperature over much of the troposphere as measured by weather balloons in the layer 1500 to 9000m above the surface (Figure 8).

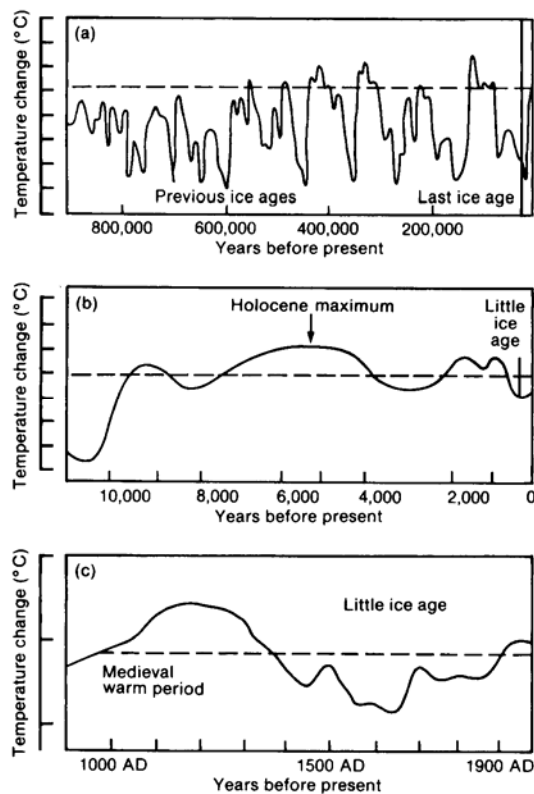


Figure 3. Global temperature variations since the Pleistocene on three time scales: a) the last million years, b) the last ten thousand years, and c) the last thousand years. The dashed line represents temperature near the beginning of the twentieth century. Source: IPCC, 1990.

It is often assumed that world temperatures are rising ever upwards; however the global temperature records show something quite different. From 1987 to 2000 there has been no warming trend if the anomalous El Niño year of 1998 is removed and the published error

bars in the temperature are taken into account. There was a small jump in temperature of about 0.2-0.3 °C following this, but global temperature from 2002 to the present has been quite stable despite steadily rising carbon dioxide concentrations in the atmosphere (Figure 9).

According to the IPCC there are no reliable predictions of future climate

"Predictions" of future climate come from mathematical climate models. But these models have not been verified, so their output is merely conjecture and not capable of being the mainstay of policy. It is an uncontroversial fact that the scientists who construct global climate models accept that they do not adequately handle key aspects of the climate system, such as the role of clouds and aspects of heat transfer in ocean circulation.

Sound science thrives on open and honest debate. But in the global warming arena, this has been suppressed or circumnavigated by shrewd tactics, such as by issuing claims of consensus among scientists, or implying that one or another group of scientists holds the high ground. Good science is not about votes or consensus. Good science thrives on debate and scepticism. The robust findings survive. In a lecture in 2004, author and scientist Michael Crichton said: "The work of science has nothing whatever to do with consensus. Consensus is the business of politics."

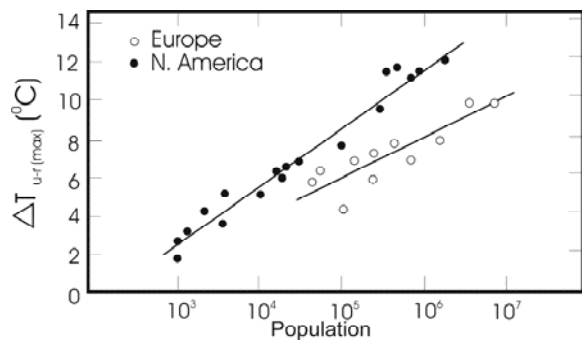


Figure 4. Relationship between urban population size and maximum urban heating effect in North America and Europe (after Oke, 1987).

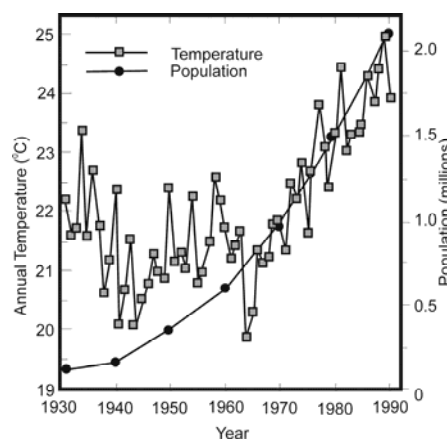


Figure 5. Mean annual temperature in Phoenix, Arizona, from 1931 to 1990 and population for the Phoenix metropolitan area. Source: Balling, 1992.

The controversy surrounding global warming comes as much from attempts by ideologues and special-interest groups to promote their own agendas as it does from scientific

uncertainty. A scientist, like anyone, can be biased, politically motivated or ideologically driven. Open, constructive debate to expose these biases is essential to progress in science, but censorship is now widespread among science journals and governmental organizations such as the UN's IPCC. It is time to address these and challenge the IPCC's monopoly on the "official view" of climate change information and advice to governments.

What if we get cooling rather than warming?

There is the widespread belief that climate warming is a proven fact and will continue. But what if we get global cooling rather than warming? There is no doubt many places would be worse off. Growing seasons would be shorter and frosts more frequent. Crop maturity and pasture growth would be slowed. Cooler periods in the past are associated with drier conditions globally.

There are benefits from current trends. Countless studies that show the effect of an increased concentration of carbon dioxide in the atmosphere is to increase the growth rates of most plants (Soon et al., 1999). This is especially so in trees but also in grasses. The results show that elevated carbon dioxide will produce enhanced growth rates with a higher photosynthesis level and greater water-use efficiency generally, and an increase in leaf longevity for grasses. An additional factor is that plants that need the boost most respond best (de Freitas, 2002). Not only do plants generally provide a substantial sink for atmospheric carbon dioxide, but plants under stress from less-than-ideal conditions — a common occurrence in nature — respond more to carbon dioxide fertilization.

The significance of all this is that as carbon dioxide concentration in the atmosphere rises, plants respond positively by providing an increasing sink for atmospheric carbon dioxide (Table 1). Assuming a doubling of carbon dioxide release as compared to current emissions, it has been estimated that atmospheric carbon dioxide levels will rise by about 300 ppm before leveling off (Idso, 1991). At that level, carbon dioxide absorption by increased terrestrial biomass may be able to absorb about 10 Gigatons of carbon per year (Soon et al., 1999). This is over three times the current net annual increase in atmospheric carbon dioxide from world fossil fuel combustion. These studies indicate that we are anticipating larger carbon dioxide concentrations in future than will actually occur.

Climate-change science is bursting with new findings and it's mostly to do with the Sun. Apart from geothermal heat, the Sun is the ultimate source of all energy on the planet, so it is not surprising solar activity is the main driver of Earth's climate. The evidence is to be found in variable solar energy output, periodic changes in solar winds and solar magnetic fields, Schwabe solar cycles and other solar influences on climate. Some solar scientists predict that that global cooling will commence around 2020 and reach its peak about 2055. Last year Russian solar physicist Khabibullo Abdusamatov predicted that global cooling will commence as early as 2012. Perhaps planning for adaptation to such cooling should be a priority for governments.

There are some human effects that can also lead to pronounced cooling. Rasool and Schnieder (1971) described the effects on global temperature of large increases in particulate matter in the atmosphere from human activities such the burning of vegetation and industrial activity. Increases in the number of these tiny particles in the atmosphere, called aerosols, have a direct as well in direct effect on cooling the planet. The direct effect is that they reduce the sunshine reaching the Earth's surface, and indirectly through acting as cloud condensation nuclei, which in turn reflect back to space heat from the sun

that would otherwise finds its way to the surface. An important point is that the effect of these particles in reducing global temperature is increasingly greater as aerosol concentration in the atmosphere rises. This is in stark contrast to the warming role of carbon dioxide.

Table 1. Emissions of carbon dioxide, atmospheric increases of carbon dioxide, and percentage carbon dioxide uptake compared for the periods 1980-1989 and 1990-1999 (IPCC, 2001). Note residual carbon dioxide is decreasing, indicating that something is capturing an ever increasing percentage of emissions (i.e. negative feedback).

| | 1980-1989 | 1990-1999 |
|------------------------------|-----------|-----------|
| Emissions (Gt/yr) | 5.4 | 6.3 |
| Atmospheric increase (Gt/yr) | 3.3 | 3.2 |
| CO ₂ uptake (%) | 39 | 49 |

Whereas the rate of temperature increase diminishes with increasing carbon dioxide in the atmosphere, the reverse is the case for aerosols. An increasing density of aerosols has an ever increasing effect on reducing the surface temperature of Earth. Because of the exponential dependence of the backscattering, the rate of temperature decrease is augmented with increasing aerosol content. An increase by only a factor of four in global aerosol background concentration may be sufficient to reduce the surface temperature by as much as 3.5 degrees Celsius. If sustained over a period of several years, such a temperature decrease over the whole globe is believed to be sufficient to trigger the equivalent of an ice age.

So what now?

Human influence aside, it is certain that natural climate change will continue. The appropriate public policy response is, first, to monitor climate accurately in an ongoing way; and, second, to respond and adapt to any changes - both warmings and the likely more damaging coolings - in the same way that we cope with other natural events such as tropical cyclones, earthquakes and volcanic eruptions.

Few policymakers address the above cautious and widely held assessment of the situation. Instead, straw-man arguments are erected and attacked, detail is endlessly obfuscated and the orthodoxy of global warming catastrophism is relentlessly repeated. In a paper this year in 'World Economics' written with colleagues (Carter et al 2007), we state that in dealing with the certainties and uncertainties of climate change, the key issue is prudence. The main certainty is that natural climate change will continue, and that some of its likely manifestations - sea-level rise and coastal change in particular locations, for example - will be expensive to adapt to. But adapt we must. Moreover reducing vulnerability to today's climate-sensitive problems will also help the world cope with future challenges from climate change whether that is due to natural variability or human causes. The most prudent way of ensuring that happens is to build wealth into the world economy and to be receptive to new technologies. This will not be achieved by irrational restructuring of the world's energy economy in pursuit of the chimera of "stopping" an alleged dangerous human-caused climate change that, in reality, can neither be demonstrated nor measured at this time

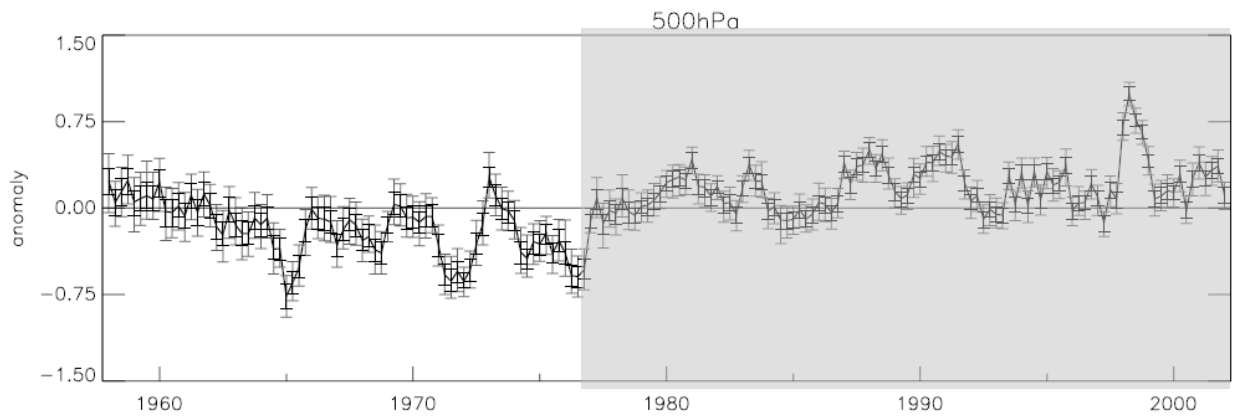


Figure 6. Global mean temperature record for the lower troposphere (500hPa) from the Hadley Centre indicating 95% confidence levels (Thorne et al, 2004). The shaded area shows the period after the sudden 1976 Pacific Climate Shift.

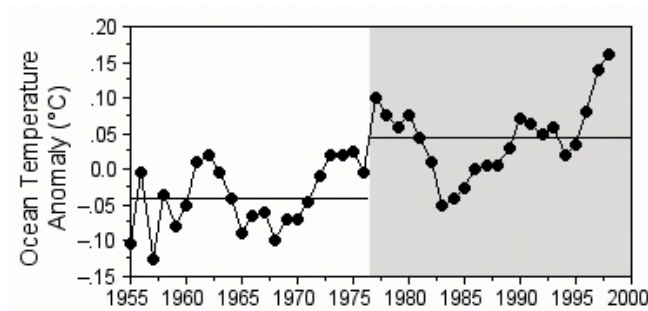


Figure 7. Tropical Pacific ocean temperature anomaly (Levitus et al, 2000). The shaded area shows the period after the sudden 1976 Pacific Shift. Source World Climate Report, 2000.

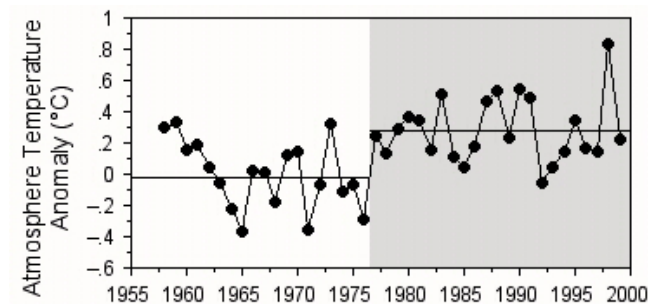


Figure 8. Global mean temperature record for the lower troposphere from radiosonde measurements. The shaded area shows the period after the sudden 1976 Pacific Climate Shift. Source World Climate Report, 2000.

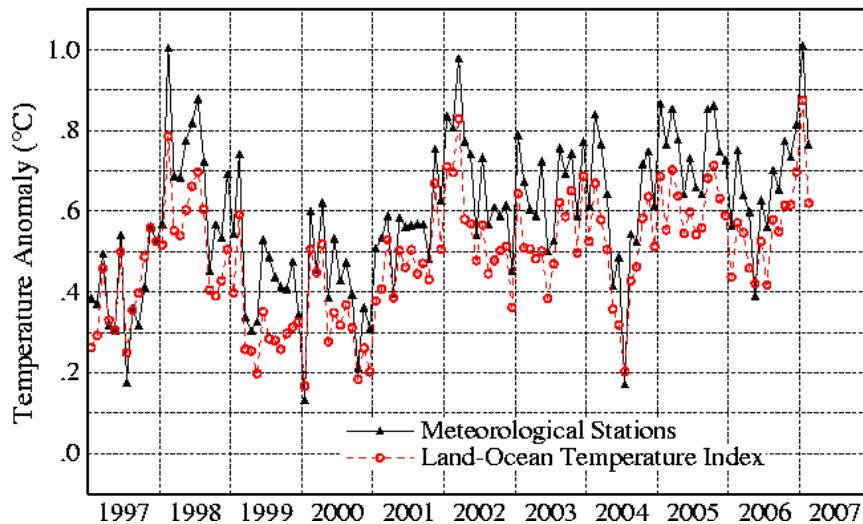


Figure 9. Global monthly mean surface air temperature change from 1997 to 2007. Source:GISS, NASA.

References

Balling, R.C. and Idso, S.B. 1989. Historical temperature trends in the United States and the effect of urban population growth. *Journal of Geophysical Research*, 94, 3359-3363.

Balling, R.C. Jr. 1992. *The Heated Debate: Greenhouse Predictions Versus Climate Reality*. San Francisco: Pacific Research Institute for Public Policy, 195p.

Carter, R.M, de Freitas, C.R.,Goklany, I.M., Holland, D and Lindzen, R.S. 2007. Climate Science and the Stern Review. *World Economics*, 8 (2), 161-182.

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 (2), 297-327. <http://www.climatechangeissues.com/files/science/defreitas.pdf>

Dettinger, D.M. and Ghil, M. 1998. Seasonal and interannual variations of atmospheric CO₂ and climate. *Tellus*, 50B, 1-24.

Flower, B.P. 1999. Warming without high CO₂? *Nature*, 399, 313-314.

Fischer, H., Wahlen, M., Smith, J., Mastroianni, D. and Deck, B. 1999. Ice core records of atmospheric CO₂ around the last three glacial terminations. *Science*, 283, 1712-1714.

Guilderson, T.M., and D. Schrag, 1998, Abrupt shift in subsurface temperature in the tropical Pacific associated with changes in El Niño. *Science*, 281, 240-43.

Idso, S.B. 1991. The aerial fertilisation effect of CO₂ and its implications for global carbon cycling and maximum greenhouse warming. *Bulletin of the American Meteorological Society*, 72, 962-965.

Indermühle, A., Stocker, T.F, Joos, F., Fischer, H., Smith, H.J., Wahlen, M., Deck, B., Mastroianni, D., Tschumi, J., Blunier, T., Meyer, R. and Stauffe, B. 1999. Holocene carbon-cycle dynamics based on CO₂ trapped in ice at Taylor Dome, Antarctica. *Nature*, 398, 121-126.

Kuo, C., Lindberg, C.R. and Thomson, D.J. 1990. Coherence established between atmospheric carbon dioxide and global temperature. *Nature*, 343, 709-714.

Levitus, S., Antonov, J.I, Boyer, T.P. and Stephens, C, 2000. Warming of the world ocean. *Science*, 287, 2225–2229.

Oke, T.R. 1987. *Boundary Layer Climates*. (2nd ed), Methuen, London, England, 435 p

Panagi, M., Arthur, M.A. and Freeman, K.H. 1999. Miocene evolution of atmospheric carbon dioxide. *Paleoceanography*, 14, 273-292.

Peterson, T.C., Gallo, K.P., Lawrimore, J., Owen, T.W., Huang, A. and McKittrick, D.A. 1999. Global rural temperature trends, *Geophysical Research Letters*, 26, 329-332.

Priem, H.A.1997.CO₂ and climate: a geologist's view. *Space Sciences Review*, 81, 173-198.

Karner, O. 2002. On Non-Stationarity and Anti-Persistency in Global Temperature Signatures', *Journal of Geophysical Research*, 107, D20. <http://www.aai.ee/~ol-avi/2001JD002024u.pdf>.

Kuo, C., Lindberg, C.R. and Thomson, D.J. 1990. Coherence established between atmospheric carbon dioxide and global temperature. *Nature*, 343, 709-714.

Panagi, M., Arthur, M.A. and Freeman, K.H. 1999. Miocene evolution of atmospheric carbon dioxide. *Paleoceanography*, 14, 273-292.

Priem, H.A. 1997. CO₂ and climate: a geologist's view. *Space Sciences Review*, 81,173-198

Rasool, S.I. and Schneider, S.H. 1971. Atmospheric carbon dioxide and aerosols: effects of large increases on global climate. *Science*, 173 (3992), 138-141.

Severinghaus J. P. and Brook E. J. 1999. Abrupt Climate Change at the End of the Last Glacial Period Inferred from Trapped Air in Polar Ice. *Science*. 286 (5441), 930 – 934.

Soon, W.H., Baliunas, S.L., Robinson, A.B. and Robinson, Z.W. 1999. Environmental effects of increased atmospheric carbon dioxide. *Climate Research*, 13.(2), 149-164

World Climate Report. 2000. Sea-ing Nothing New Under the Sun. *World Climate Report*, 5 (14).