A climate of scepticism

Philip Lloyd, Energy Institute, CPUT

The world is getting a little warmer. The measurements by which we know that it is warming are poor. The figures are not accessible, and keep on changing\(^1\). Many points at which temperature is measured are badly sited, and bound to give misleading results\(^2\). But in spite of this, most accept that the world is a little warmer than it was 150 years ago.

There are some fairly clear signals of a warmer world. The Arctic ice is less than it was\(^3\). Many glaciers are retreating\(^4\). Some glaciers – for instance, those on Kilimanjaro – are shrinking because the long-term precipitation is less than it was 150 years ago, not because it is warmer\(^5\). Others are shrinking from a warmer climate.

Where the sceptic differs from many other scientists is in ascribing the warming to human activities – specifically, the burning of fossil fuels and the concomitant rise in the carbon dioxide concentration in the atmosphere. The hypothesis is that the carbon dioxide traps infra-red radiation that would otherwise escape to space. This means that some of the energy received from the sun is not lost, and the trapped energy leads to a warming of the globe.

The physics of how carbon dioxide traps infra-red radiation is well known\(^6\). But there are other molecules in the atmosphere that also trap infra-red radiation. Water vapour is the predominant “greenhouse gas”\(^7\). What is not so clear is the extent to which the trapping of energy causes heating. There are wonderful mathematical models that claim to show how heating occurs. Unfortunately, all the models suffer from identifiable flaws, a point considered later.

A prime difficulty with the anthropogenic warming thesis is that it is not known how much of the warming is natural and how much might be caused by carbon dioxide. It is simple to illustrate this. Figure 1 shows the global temperature record as kept by the Climate Research Unit at the University of East Anglia\(^8\).

Figure 1 Global temperatures, relative to 1950-1990 average
The global temperature dropped from 1850 to 1860; rose until 1880; dropped until 1910; rose until 1945; dropped until 1980; rose until 2000; and has dropped slightly since then.

Figure 2 shows the carbon dioxide record. Careful measurements have been made at Mauna Loa on Hawaii since 1958. The pre-industrial level of CO$_2$ in the atmosphere is generally accepted to have been about 280 ppm. Figure 2 shows a reasonable extrapolation of the data back to about 280 ppm in 1800.

![Figure 2 Atmospheric CO2 concentrations, measured and estimated.](image)

It seems entirely reasonable that the measured rise is the result of fossil fuel consumption. Figure 3 shows annual CO$_2$ emissions over time. In 1900 it was just under 2 billion tons per annum; by 1943 it was at 5 billion tons and then fell back and only exceeded 5 billion tons again in 1947. Thereafter it grew rapidly, passing 10 billion tons in 1963, 15 billion in 1971, 20 billion in 1986 and 30 billion in 2006.

![Figure 3 Annual CO2 emissions from fossil fuel consumption.](image)

Comparison of Figures 2 and 3 makes it clear that the rise in atmospheric carbon dioxide is almost certainly directly related to the emissions from fossil fuels. However, the low levels of emissions up until about 1945 show that the impact of the fossil fuel combustion prior to 1945 must have been very small if not negligible. Therefore the changes in global temperatures prior to 1945, shown in Figure 1, were largely natural. The additional carbon dioxide from human activities cannot have played a significant part in the changes prior to 1945.
If most of the temperature changes prior to 1945 were largely natural, then there is great difficulty in determining how much of the temperature change post-1945 is natural and how much might be driven by increasing carbon dioxide. This raises the question of what the natural variation in temperature might be.

To answer this question, we turn to the Vostok ice core record over the past 9000 years\textsuperscript{12}. The core was sampled every metre of depth, which represented ~20 years of accumulation in the upper layers and ~50 years in the lower levels. The temperature was estimated from differences in the oxygen isotope ratios. While a point measurement such as this cannot give a good measure of the average global temperature, it is a reasonable measure of changes in global temperature, and it is primarily temperature changes that are of interest.

The data are shown in Figure 4. There has been a slight cooling over the past 9 millennia, as shown by the least-squares line. The data were therefore detrended before further analysis – the mean temperature at any one date was added to the reported relative temperature. The detrended temperatures were what is known as “normally distributed”, i.e. there was nothing abnormal or skewed about them. Then the rate of change between each detrended temperature and the temperature approximately 100±20 years earlier was calculated and expressed as a rate per century. The results were also normally distributed, with a standard deviation of 0.83°C per century.

![Figure 4. Relative temperatures over the past 9000 years.](image)

Thus there is about a 2:1 chance that the temperature may vary by up to 0.83°C per century from natural causes, but only about a 1 in 10 chance that it will vary by more than 1.67°C naturally. Between 1900 and 2000 it varied by about 0.9°C, which is, therefore, within the range of natural variation. And that, in simple terms, is why there is scepticism about the thesis that carbon dioxide is causing global warming – there is no clear signal of any such warming effect.

However, the proponents of the anthropogenic warming thesis claim to have models that show how added carbon dioxide will lead to a warmer world\textsuperscript{13}. There are major problems with these models, not least of which is the fact that the proponents claim that doubling the CO\textsubscript{2} in the atmosphere will increase the temperature by over 3°C. This is well above any physical reason\textsuperscript{14}. It results from arguments about the effect of water vapour in the atmosphere, which is supposed to exacerbate the effect of increased CO\textsubscript{2}. 

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The doubling effect is so far invisible. Other estimates have suggested that doubling the CO$_2$ may increase the global temperatures by less than 1°C. The evidence for this is building. For instance, there has been about a 40% increase in atmospheric CO$_2$ since 1945, which would imply 1.2°C of warming if doubling the CO$_2$ caused a 3°C rise. Figure 1 shows that the actual warming over this period has only been about 0.4°C. Has the globe cooled by 0.8°C while the added CO$_2$ has been warming us? It seems unlikely.

There are further reasons to doubt the models. For instance, Figure 5 reproduces Figure 10.7 from the IPCC Fourth Assessment Report. The sections are from the South Pole on the left to the North Pole on the right. In the atmosphere, altitude is expressed in terms of pressure, with sea level at 1000hPa and 11km being about 200hPa. Stippling on the figures shows regions where all the models agree within narrow limits.

![Figure 5. Model predictions of global temperature changes: atmospheric upper, oceanic lower](image)

The area of particular interest is the ‘blob’ over the equator and centred at about 200hPa. In 2011-2030 it is just less than 1.5°C above today’s ground level temperatures. By 2046-2065 it is expected to be about 3°C warmer, and by 2080-2099 about 5°C warmer. Thus this region is expected to warm by about 0.6°C per decade, if the models are to be believed.

For about the last 60 years, balloons carrying instruments have been flown into this region to obtain data for weather forecasts. Examination of the temperature records has failed to reveal any heating whatsoever. Satellites have been flown since the late 1970’s, and some of their views through the atmosphere can be interpreted as average temperatures of particular regions. The satellites show very slight warming – but nothing like 0.6°C per decade.
In science, a single experiment can suffice to disprove a theory, if the experiment finds an unexpected result. Any theory whose predictions fail experimental tests should be abandoned without further ado. In the present case, the anthropogenic warming hypothesis has led to theoretical models, but those models have failed experimental proof. Such is the strength of belief in the anthropogenic thesis, however, that the modellers are most reluctant to abandon – or even revise – their models. This is one of the strongest reasons for scepticism.

The anthropogenic thesis has also led to many predictions of the possible conditions in a warmer world. Some, such as the impact on the cryosphere, seem to be borne out. However, the models which, as noted earlier, are highly suspect, suggest such things as dramatic changes in precipitation. The evidence is negligible.

For instance, there is a very long record of rainfall for England and Wales, shown in Figure 6. There is absolutely no sign of any change in the rainfall pattern over the last 60 years. Over the entire period, the annual average over 25 years is 913 ±18mm. The 18mm is the maximum deviation, not the standard deviation!

![England & Wales Precipitation](image)

**Figure 6. A 240-year rainfall record**

Similarly, there are repeated suggestions that the sea level will increase rapidly due to the melting of ice and the warming of the oceans (warm water is less dense than cold, so it occupies a larger volume). It is true that the sea level is rising, but you seek in vain for any evidence that it has risen significantly faster since 1945 than before. Figure 7 illustrates this, using the tide gauge data from New York which extends back to 1858 with a gap from 1879 to 1892. The regression line for all the data from 1870 to 2011 has a slope of 2.947mm/a; that from 1945 to 2011 has a slope of 2.948mm/a. There has been no significant increase in the rate of sea level rise at New York for the past 140 years.
Many of the fears about sea level rise are unfounded. Yes, the sea is rising slowly. Satellite measurements since the early 1990’s confirm a rate of rise of about 3mm/a\textsuperscript{21}. However, there are already defences against the sea. It is necessary to allow for tides, storm surges and even tsunamis. The existing defences are measured in metres, not mm. An increase in the average level of 3mm/a can be offset by raising the defences by an additional brick every 30 years or so. The rising sea level is not a threat.

Of course, there are events where the defences prove inadequate. This was the case when Hurricane Katrina struck New Orleans. Several years previously, it had been reported that the levees were likely to fail\textsuperscript{22}. They were old, and lacked modern design features. They failed, as anticipated, when the storm surge arrived. Their failure had nothing to do with ongoing rise in sea levels, and everything to do with weak defences.

However, there are repeated references in the literature to the New Orleans levee failure being the result of “climate change.” This illustrates a feature of the debate that reinforces my scepticism. Disasters that have nothing to do with a changing climate are ascribed to “climate change” as a means of raising awareness about the supposed threats.

Nothing illustrates this aspect of the debate better than the ongoing accent on “extreme events.” A violent storm, such as the recent Sandy that struck New York, is immediately seized upon as evidence of “climate change.”

However, weather is ever variable. The vigour of every natural phenomenon has a wide range. Many phenomena, for example rainfall, are best described by a distribution which is very strongly skewed. Such distributions are quite counterintuitive when it comes to trying to define what constitutes “extreme”.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure7}
\caption{A 150-year sea-level record.}
\end{figure}
The problem is to decide how wide is the ‘normal’ range, a decision essential for describing an event as abnormal or ‘extreme’, that is, lying outside the normal range. A lot of data is necessary to define ‘normal’, which implies that data must be collected over a long period. The long period may exceed a human lifetime. If so, then few living individuals can have experienced the truly “extreme” events – and an event much less than extreme may be seized upon as an example of an extreme event when in fact it is no such thing.

In the case of storm Sandy, there has been an assessment of the intensity of all hurricanes and “post-tropical storms” (of which Sandy was one) that made landfall on the continental United States between 1900 and 2012. The data are shown in Figure 8. A person born in 1900 would probably have experienced their most extreme event in 1936. However, that person might have lived to the age of 106, and would have seen two stronger storms. That might have convinced him/her that the world was getting worse. He/she would have been wrong, of course – the random nature of extreme events would have fooled them.

Figure 8. Power dissipation index of storms which made landfall on the US, 1900-2012

This illustrates quite nicely how long one must wait before one can determine even the 100-year event – and how just because there has been such an event, another nearly as bad can turn up in less than 100 years after that! The statistics of extreme events are counterintuitive, and very long baselines are needed before it is possible to decide if something is extreme or not.

There has been extensive concern about extreme events, partly because almost every day somewhere on the globe there will be an event that might be describable as ‘extreme’. The IPCC has issued a special report on the subject. It can probably best be described as ‘delphic’ – a series of very cautious pronouncements that can be interpreted in different ways, depending on your viewpoint. Probably the best measure of the extent to which extreme events should be viewed as likely to be caused by climate change comes from a study of deaths caused by severe weather. The results are shown in Figure 9.
It is clear that the absolute number killed each year has dropped since the 1920’s. In relative terms, the drop has been even more dramatic, from a peak of 241 per million to 5 per million. At this low rate, it is clear that extreme weather no longer presents the same risks as faced previous generations.

The reasons for this steep decline are several. One is vastly better weather prediction, so that there is now adequate warning about possible extreme weather conditions. Secondly, there is much better communication of impending severe weather. Finally, with improved knowledge of severe conditions, mankind has learned to design structures that protect us from the hazards.

The final scare story that needs to be laid to rest is that of species extinction as a result of climate change. The popular press reports this regularly. “‘Climate change now represents at least as great a threat to the number of species surviving on Earth as habitat-destruction and modification,’ said Chris Thomas, a conservation biologist at the University of Leeds in the United Kingdom. - - the predicted range of climate change by 2050 will place 15 to 35 percent of the 1,103 species studied at risk of extinction. The numbers are expected to hold up when extrapolated globally, potentially dooming more than a million species.”

However, science prefers predictions that are testable. A recent serious study concluded that “Surprisingly, [there is no] straightforward relationship between local extinction and limited tolerances to high temperature.” Indeed, this follows from common sense. Figure 10 shows the average monthly conditions for Cape Town. The boxes show the average daily maxima and minima, the lines show the highest and lowest temperatures ever recorded, and the lower and upper horizontal lines reflect the annual average temperature in 1900 and 2000 respectively.
It is reasonable to ask how the relatively small annual average temperature change can be detected by organisms that every year are likely to be exposed to changes some 50 times larger, to which they seem perfectly adapted.

The final reason for ongoing scepticism is the behaviour of some of the proponents of the climate change thesis. It starts with the Intergovernmental Panel on Climate Change. It has become a political body rather than a technical body. The best illustration of this is the publication of the Panel’s reports. It is preceded by the publication of a summary for policy makers. This summary often differs in material respects from the findings of the main report, and invariably puts a politically correct slant on what is supposed to be a dispassionate review of the scientific literature.

The IPCC’s work is not aided by the fact that much of the work reported is not scientific, but reproduced from activist literature. The Canadian journalist Donna Laframboise has documented this problem in detail.

For example, she tracks how a relatively unknown professor of epidemiology, Anthony McMichael, who had written a polemic in 1991, became a lead author of the chapter on malaria and the health effects of climate change, even though he had no professional publications about malaria and even though some of his conclusions were rejected by members of the Panel who were world experts on the subject.

Sections of McMichael’s book appeared almost verbatim in the IPCC’s Assessment Report in 1995. This led directly to the thesis that global warming will increase the spread of malaria. There is no evidence that this is likely, because malaria has been known in cold climates for centuries. Moreover, the spread of malaria is known to be almost entirely a function of social conditions and public health.

The fight against malaria is not helped by those who claim that climate change is part of the problem. If they had their way, the accent would be on addressing climate change rather than fighting malaria. This illustrates a danger of accepting a possibly flawed thesis too uncritically – resources may be diverted from essential activities affecting the lives of millions in the hope that there will be a positive impact on putative risks that could affect billions. Before taking such a decision, one needs to be very certain indeed that the putative risks can be avoided by the diverting of resources.

Another reason for scepticism is that the debate about climate change has revealed some major imperfections in the scientists themselves. Some players on the human-induced climate-change playing field have shown themselves to be only too human in the defence of the indefensible. For example, two scientists did what scientists are supposed to do – they peer-reviewed the work of some 200 other scientists. They reported that:

“Across the world, many records reveal that the 20th century is probably not the warmest nor a uniquely extreme climatic period of the last millennium.”
This was totally contrary to the thesis that today’s warming was exceptional. Accordingly the believers in human-induced change forced the editor of the journal that had published the review to resign, and went out of their way to try to destroy the reputations of the two authors. All this (and more) was revealed when a series of emails found its way into the public domain from the Climate Research Unit at the University of East Anglia\(^3\).

The world is a bit warmer. The carbon dioxide levels of the atmosphere are increasing. Plants are doing better than before because of the higher carbon dioxide\(^2\). The sea is rising in a barely detectable way. Climatic disasters are no worse than previously. The animal kingdom is being squeezed by the growth of a single species, us, but that has nothing to do with global warming.

And that is why there is a climate of scepticism.

References

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