Facts and fictions about Australia's environment and man-made warming

Setting the record straight about claims of an overwhelming consensus about a human influence on climate and the impact of man-made climate on Australia's environment

Submission to the Garnaut Climate Change Review

by

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Above image:- An almost spherical cloud photographed near Woodend, Vic, in December 2004

"*We must always think about things, and we must think about things as they are, not as they are said to be*"
- George Bernard Shaw

"*Every man has a right to his opinion, but no man has a right to be wrong in his facts*."
- Bernard M. Baruch

"*The fact that an opinion has been widely held is no evidence whatever that it is not utterly absurd, indeed, in view of the silliness of the majority of mankind, a wide-spread belief is more likely to be foolish than sensible*"
- Betrand Russell

"It is the use of bureaucracies for advocacy that are driven by political agendas that is the biggest problem. They have
- *almost endless funds;*
- *direct and free access to data;*
- *control of the production, analysis and dissemination of the data;*
- *direct access to the politicians who if they question are reminded they don't know or understand the science;*
- *all the vehicles and power inherent in government labeled documents;*
- *in most cases no external peer review of their published work;*
- *no accountability to the taxpayers through elections;*
- *a tendency to perpetuate a position taken rather than question, challenge and possibly reject as the scientific method requires;*
- *direct influence and control over the policies and practices of all other government departments, especially those engaged in environmental issues."*

- Tim Ball, Canadian climatologist,
in a recent posting to an Internet discussion forum

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Executive Summary

The Garnaut Climate Change Review assumes that substantial evidence exists to show that man-made emissions of carbon dioxide have caused the increase in temperatures since 1975 and that this evidence is backed by a wide consensus among experts.

According to various data neither of these assumptions is valid.

Over the last ten years (i.e. 1998-2007) the correlation between carbon dioxide concentration and average global temperature has been particularly poor. Since 2002 average global temperatures have been stable or falling despite the increasing concentrations of carbon dioxide in the atmosphere. Temperatures across that period have remained below the level set in 1998.

(I ignore data from the Goddard Institute of Space Studies (GISS) that indicates otherwise because that data has never been independently audited, nor is it used extensively by the Intergovernmental Panel on Climate Change (IPCC)).

Who should be more expert in these matters than the various authors and reviewers of the IPCC Working Group I (WG I) report for the IPCC's Fourth Assessment Report that was released during 2007? The key text of the crucial chapter of the WG I report, the chapter in which human activity was blamed for recent warming, was the product of about 5 authors and it was explicitly supported by just 5 reviewers of more than 100 individuals who were invited to comment, and perhaps a further 190 governments. If there is an overwhelming consensus among these experts then it is that the claims in that key chapter were not worth supporting.

The evidence advanced by the IPCC for this human influence on climate is particularly weak. It assumes that scientific understanding of climate is thorough enough to both create accurate models and to know what is normal, and yet other IPCC statements show that the level of scientific understanding of many climate factors is poor. The quality of 23 climate models can be seen when the average of those models fails to replicate historical temperatures across the twentieth century.

The CSIRO's various climate reports consistently assert a human influence on climate but their evidence, if such is presented, is a rehash of the weak evidence from the IPCC. The recent "Climate Change in Australia" report that the CSIRO co-authored includes that weak evidence and fails to fully investigate whether changes in the pattern of the Southern Oscillation, a noted major influence on Australia's climate, may have played a major part. But that is nothing new for CSIRO climate reports.

The same CCA report relies on artificial reconstructions of sea level to make certain claims and never questions the accuracy of that synthesised data.

Misunderstandings, uncertainties, questions of the integrity of key data and observations that refute common claims all plague the question of man-made warming.

The essential fingerprints of warming caused by greenhouse gases cannot be found in observations, nor do those observations support climate model predictions. The theoretical warming influence of carbon dioxide does not increase in a linear fashion with gas concentration but according to logarithmic relationship. This means that each additional increase of 50ppm of CO2 will cause less and less theoretical warming but how that translates into temperature figures is currently one of the major debates in climatology.

Add to that some serious questions about the accuracy of key temperature data, that claims about sea level changes are refuted by significant expert opinion and observational data, and that the much-neglected Great Pacific Climate Shift of 1976 produces a better correlation to recent rising temperatures than does carbon dioxide and confidence in popular claims should begin to waver.

On the Australian scene almost every climate factor can be correlated with that climate shift and the consequent changes to the El Nino-Southern Oscillation (ENSO), even variations in temperature and in sea level. The trends in individual sea level records can be attributed to variations in ENSO and to a number of localised natural and man-made causes. To extrapolate those trends due to a belief in man-made warming is without merit.

Contrary to popular perceptions, the sea temperature data for Australia's Great Barrier Reef shows no sign of significant warming and so claims of bleaching due to man-made climate change are not supported by the evidence.

There is no demonstrable credible consensus that anthropogenic emissions of carbon dioxide have influenced either global climate or Australia's climate. There is however good evidence that natural causes have been responsible for a shift in Australia's climate since 1976 and that urgent action is required to mitigate against those changes.

1. Introduction

The first of the terms of reference for the Garnaut Climate Change Review is to take account of...

> "[t]he likely effect of human induced climate change on Australia's economy, environment, and water resources in the absence of effective national and international efforts to substantially cut greenhouse gas emissions"

And it is noted

> "This Review should take into account the following core factors: ... [t]he weight of scientific opinion that developed countries need to reduce their greenhouse gas emissions by 60 percent by 2050 against 2000 emission levels, if global greenhouse gas concentrations in the atmosphere are to be stabilised to between 450 and 550ppm by mid century."

If there is any "weight of scientific opinion" about a need to reduce carbon dioxide emissions then it pre-supposes that some consensus exists about an acceptable quality and quantity of evidence for the theory that anthropogenic emissions of carbon dioxide have a significant influence on global temperature.

In a similar fashion to claim that the absence of a national and international effort to reduce greenhouse gas emissions will have an impact on Australia pre-supposes that a human activity has a significant influence on climate and therefore upon the Australian economy environment and water resources.

In this submission I will present information that

(a) refutes any notion of a consensus of man-made warming among climate experts

(b) shows that there is precious little evidence for a human influence on climate

(c) shows that certain key assumptions or popular beliefs that apply at a global level are without foundation

(d) shows that claims about human influences on Australia's climate are very dubious

and

(d) shows that changes to Australia's climate have a natural cause and by implication any changes will be within natural limits.

To do this I will start by drawing conclusions about the temperature pattern over last 10 years. This will be followed by evidence that the only demonstrable consensus among the most significant group of experts was to *not* support the theory of man-made climate change.

The next two sections will deal with the credibility and evidence presented by the Intergovernmental Panel on Climate Change (IPCC) and Australia's CSIRO. Then follows two sections dealing with issues in the global arena and Australia respectively. In particular these sections will show several graphs of critical data that refutes the common claims.

Much of the information in this submission comes directly from data sources rather than being the opinions and interpretations of others. This data is presented in graphical form so that the reader is free to draw one's own conclusions.

Data sources are noted in this document where relevant, the only exception being the variety of data available via the website of the Australian Bureau of Meteorology, especially through the web site http://www.bom.gov.au/cgi-bin/silo/reg/cli_chg/timeseries.cgi .

2. The temperatures of the last 10 years

The temperature data over the last 10 years shows good reason to doubt a human influence on climate.

Figure 1-1 shows the average global temperature each month over the last 10 years according to dataset known as HadCRUT3v from the UK's Climatic Research Unit, the same dataset that the IPCC uses in its assessment reports. Shown with this data is the concentration of carbon dioxide in the atmosphere. The relationship between the two graphs is poor, most notably near the start and end of the period.

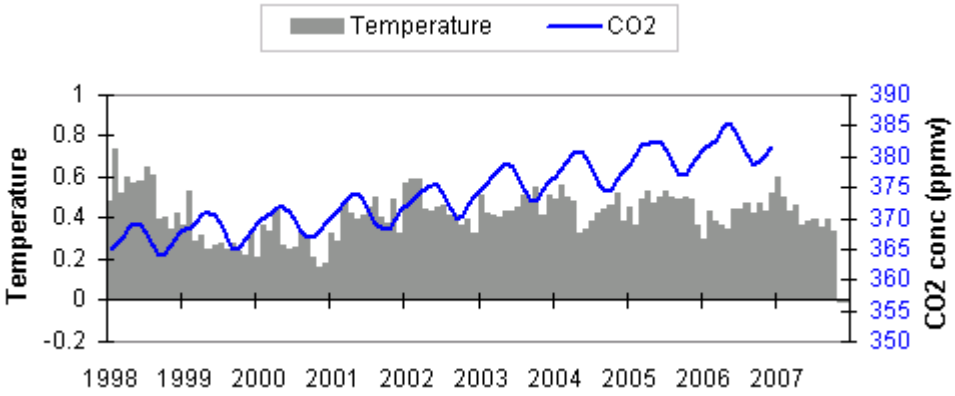

Figure 1-1. HadCRUT3v average global temperature and carbon dioxide over last 10 years

Figure 1-2 shows, for the same period as figure 1-1, the University of Alabama, Huntsville (UAH) version of the monthly average temperatures in the lower troposphere, the data for which is determined by Microwave Sounder Units mounted on satellites. Again carbon dioxide concentration is shown. The temperatures appear to have risen in late 2001 and been relatively stable since that time despite the increase in carbon dioxide.

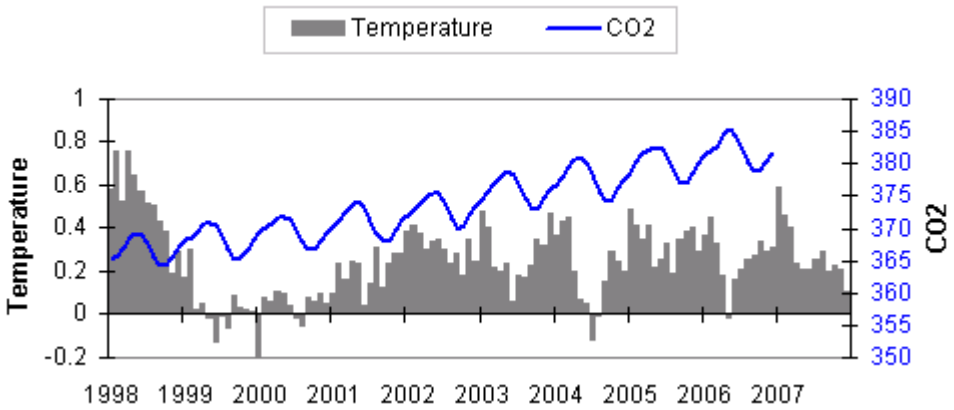

Figure 1-2. UAH lower tropospheric temperatures and carbon dioxide over last 10 years.

Figure 1-3 shows the lower tropospheric temperatures determined by Remote Sensing Systems (RSS) using an alternative method to UAH, again with carbon dioxide concentration. This shows the same increase in temperature in late 2001 but a relatively steady decrease since January 2005. In fact the temperatures in the last two months of 2007 are below the RSS zero line. The correlation with carbon dioxide is again poor.

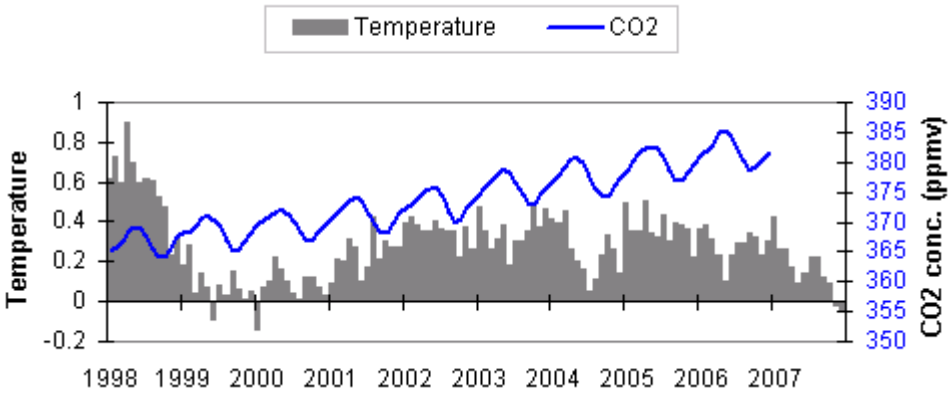

Figure 1-3. Lower tropospheric temperatures according to RSS

The above figures show that temperatures have not risen over the last 6 years and they remain well below the levels of 1998 despite the increase in atmospheric carbon dioxide in the atmosphere.

If there is no warming then how can there be man-made warming?

Maybe it will be claimed that a human influence is being masked by the action of other climate forces. But is there any evidence of the substantial cooling forces that would be necessary to counter-balance man-made warming?

Scientists recognise two major cooling forces on climate, namely volcanic activity sending fine particles in the air and causing weak shading, and the cooling influences of La Nina events. The former can be dismissed because the period in question was volcanically very quiet apart from a brief burst of activity from Mount Merapi in Indonesia. The latter can be dismissed because figure 1-5 clearly shows that negative SOI values, i.e. ENSO conditions towards El Nino events, dominated the period under consideration except for 1999-2001.

In other words no recognized natural cooling influences acted on the global on climate from January 2002 and yet no warming occurred. Surely if man-made warming is a product of carbon dioxide emissions we should have seen some increase in temperatures. The logical conclusion is that any human influence on climate is exceptionally weak or non-existent.

The temperature data does not support the contention that the Earth has warmed over the last 10 years due to increasing concentrations of carbon dioxide. One must wonder if warming has EVER been due to carbon dioxide.

3. The so-called consensus on man-made warming

The notion of a consensus, although it means little in science, is often part of the "package" of so-called evidence for a human influence on climate.

The claim of consensus appears to have started with Al Gore who, according to Environmental News on 1 April 2000, used this expression shortly before prior to his unsuccessful bid of the presidency. Environmental News claims that Gore said:

> "There is **overwhelming scientific consensus** that human activity is contributing to global warming . . . which can lead to serious public health consequences . . . and extreme weather." [*my emphasis*]

This is a curious comment because there was little evidence to support it. The IPCC's Third Assessment Report was not due for release until January of the next year, a full 7 months away, and either the second draft was currently in preparation or it was in the hands of the reviewers. Perhaps Gore was relying on a 1996 survey by Bray and von Storch[1] that had indicated considerable support for the claim but it was hardly overwhelming.

On October 11 of that year (2000) the UK's Guardian newspaper stated:

> "Hansen and his colleagues accept the **scientific consensus** that carbon dioxide is responsible for roughly half of all man-made global warming over the last half century." [2] [*my emphasis*]

Again there appears to be little evidence for that consensus. The "Hansen" in question was James Hansen, the NASA employee who is well recognized for making extreme claims, and it is not beyond possibility that Hansen had referred to a consensus and The Guardian willingly paraphrased his comments.

On 26 October of the same year New York Times journalist Andrew C Revkin wrote

> "Many [IPCC] panel members said that the summary represents the **closest thing to a consensus possible in science**, which is generally driven more by questioning and challenges than esprit de corps." [3] [*my emphasis*]

His expression, "closest thing to a consensus", spread rapidly through the English speaking world with the same or almost identical words appearing in the UK's *Guardian* [4] newspaper and the *Irish Times* [5] the very next day and in Melbourne's *Sunday Age* [6] two weeks later.

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1 Bray, D and H. von Storch, (1997) Survey explores Views of 400 Climate Scientists *United Nations Climate Change Bulletin*, issue 14, 2nd quarter 1997, pp 6-7

2 **Second guess on the gas,** *The Guardian*, (London, England), October 11, 2000

3 **A Shift in Stance on Global Warming Theory** Andrew Revkin, *New York Times* Oct 26, 2000 pg. A22

4 **Earth will get hotter than expected** *The Guardian*, (London, England) October 27, 2000

5 **Study finds global warming is greater than predicted UN panel** *Irish Times*, (Dublin, Ireland) October 27, 2000

6 **All together in the Greenhouse** (editorial), *The Sunday Age*, (Melbourne, Australia) Nov 12, 2000

On 12 November 2000 the then chairman of the IPCC, Robert T Watson, started to provide an official imprimatur on the claim. His address to the 6th conference of UNFCCC parties contained the statement

> "The **overwhelming majority of scientific experts**, whilst recognizing that scientific uncertainties exist, nonetheless believe that human-induced climate change is inevitable." [7] [*my emphasis*]

This was repeated about a week later when he said to the same conference

> "As you debate the weighty issues associated with effective implementation of the Convention and the Kyoto Protocol let me remind you that the **overwhelming majority of scientific experts**, whilst recognizing that scientific uncertainties exist, nonetheless believe that human-induced climate change is already occurring and that future change is inevitable." [8] [*my emphasis*]

That conference went into limbo and resumed in July 2001. Watson was there again, reiterating his claim.

> "The **overwhelming majority of experts** in both developed and developing countries recognize that scientific uncertainties exist, however, there is little doubt that the Earth's climate has warmed over the past 100 years in response to human activities and that further human-induced changes in climate are inevitable." [9] [*my emphasis*]

Revkin's comments may have come from IPCC members – i.e. the government representatives on the panel – but whether they reflect the opinion of experts is another matter. The governments in question were largely those that had already signed and ratified the Kyoto Agreement so support for the claim of man-made warming from this quarter was hardly surprising, as was the likelihood of generalisations from the group.

Watson's statements about a "majority of experts" imply that all the IPCC's authors and reviewers, and perhaps others beyond that sphere, took some kind of vote on the claims. But this is contrary to the procedures under which the IPCC operates.

The authoring system of each IPCC assessment report is multi-layered. Each chapter has Coordinating Lead Authors (CLAs) who have authority across the entire chapter. Lead Authors (LAs) deal with specific sections of chapters and they merge the input from the Contributing Authors who responded to invitation of the Lead Author and submitted material pertaining to their areas of expertise.[10] The number of contributing authors on any topic is hardly likely to exceed 5 for the sheer logistical problem of handling the different submissions.

The text that appears in any section of the IPCC Assessment Reports is essentially the consensus of probably fewer than 10 authors - the "Chair" (i.e. head) of that Working Group, the CLAs and the LAs and an unspecified number of contributing authors.

Expert reviewers in the relevant subject area examine the first and second drafts of the report but the CLAs and LAs (and review editors) are the "gatekeepers" who control the text

7 IPCC document http://www.ipcc.ch/graphics/speeches/robert-watson-november-13-2000.pdf
8 IPCC document http://www.ipcc.ch/graphics/speeches/robert-watson-november-20-2000.pdf
9 IPCC document http://www.ipcc.ch/graphics/speeches/robert-watson-july-2001.pdf
10 IPCC document http://www1.ipcc.ch/pdf/ipcc-principales/ipcc-principales-appendix-a.pdf

because they are under no obligation to modify the text in response to the reviewers' comments, unlike with a peer reviewed paper in a journal. Reviewers can and do object to passages of text, and none have the opportunity to comment if they feel that the modifications after the second review are inadequate. The reviewers cannot be assumed to concur with the final draft and they cannot be automatically included in any "consensus".

The final draft is presented to a plenary of government representatives for approval. According to people who have attended such sessions, the coordinating lead authors defend the draft of the text and the chair of the working group typically requires substantial justification from the plenary attendees before the text is altered. This process seems more like reluctant acquiescence than staunch support for the consensus of the authors.

The IPCC reviewers are not "peer reviewers" in the normal sense because with few exceptions (but sometimes critically!) the material cited in the IPCC reports comes from peer-reviewed journals although the quality of that peer-review is sometimes debatable. The IPCC peer review is only a question of whether the text that appears in the draft is a true and accurate account of the peer reviewed material.

Many expert reviewers cannot be considered to be impartial because they have clear vested interests. These vested interests could arise because the reviewer is also an author of the chapter in question or of other chapters. He or she might be directly involved with other aspects of the creation of the report, might be the author of a cited paper, might represent a government that has already made its position clear, might work for a research organization whose projects are biased towards a certain position discussed in the chapter, or may no longer fall into those categories but have developed a professional reputation based on work in one or more of those areas.

(There is no denying that finding impartial reviewers is extremely difficult but much of the blame for that rests with the IPCC's dominance of climate science and the high profile publicity that the climate now garners.)

Fewer than 10 authors reaching consensus on a summary of peer-reviewed papers about climate is scarcely overwhelming, even more so when decisions about the inclusion of certain points of view was based only on the number of papers on that subject and not the scientific truth of the situation, which was outside their remit.

For the first time, and largely due to Freedom of Information legislation, the reviewers' comments for Working Group I of the Fourth Assessment report have been made available to the public.

These comment are clear evidence of how little consensus exists.

First it needs to be said that the Working Group I (WG I) report establishes the scientific basis is pivotal to the reports from the other two working groups. In theory work on those other reports cannot be undertaken until the conclusions of WG I are established but in practice all three reports were developed in parallel, which suggests that the conclusions of the WG I were pre-determined and makes a mockery of claims of a consensus.

The IPCC's expert reviewers have differing areas of expertise so every reviewer does not examine every word of every chapter of every report. An average of 65 reviewers commented on each chapter of the second order draft (i.e. penultimate draft) of the Working Group I report, with the number ranging from 32 to 100.[11] That average of 65 is about 1/40th of the 2500 reviewers that the IPCC implies were part of the consensus.

11 see http://mclean.ch/climate/IPCC_review_updated_analysis.pdf

An average of 25% of reviewers' comments were rejected for each chapter of that second draft with a minimum rejection rate of 9.5% of reviewers' comments in one chapter and a maximum 58.1% for another.

The crucial chapter in the entire IPCC Fourth Assessment Report is chapter 9 of the Working Group I report because this is where human activity is blamed for the reported warming of the last 50 years.

Earlier chapters discuss historical observations and theories without attempting to attribute blame, so they provide data but have no direct bearing on the conclusions in chapter 9. Later chapters and the other two reports are very much based on the assumption that the 9th chapter is accurate and correct. So it's on the basis of chapter 9 that the majority of the IPCC's Fourth Assessment Report stands or fails.

The impression one gets from the IPCC is that the fundamental claim made in that chapter 9 was supported by an overwhelming majority of experts but the true picture is quite different.

As part of the normal IPCC procedure the drafts of each chapter are sent to all authors so they might review it so, presuming that this only means all authors of the chapter in question rather than all authors of all chapters, it appears that the 56 authors of chapter 9 were given the opportunity to comment on the second draft. Only seven authors commented on the chapter and they joined another 55 reviewers, making a total of 111 individuals or government representatives (which might involve more than one person) known to have had the opportunity to review that chapter.[12]

Only 62 of those 111 commented on chapter 9 and 55 of them having demonstrable vested interests.

Among the reviewers of that chapter were 8 government representatives and so it seems very likely that all governments were presented with copies of that second draft and invited to comment and perhaps that figure of 111 should be increased to almost 300.

What is more certain is that just 5 reviewers explicitly supported that chapter, but 4 had vested interests and the other made just this single comment for the entire 11-chapter report.

The overwhelming majority of the expert reviewers, and others known to have the opportunity to comment, did *not* endorse the IPCC's claim of a significant human influence on climate.

As noted above, the final step in the creation of an IPCC Assessment Report is the presentation of the final draft to a plenary of government representatives for its approval. Given that most governments signed and ratified the Kyoto Agreement some years ago, it would be a brave or foolish representative who disagreed to a notion that was already endorsed by his or her government and most likely incorporated into existing government policy.

The credentials and expertise of these government representatives can also be questioned when supposedly the best experts are directly involved in the process of creating the IPCC reports. Are these representatives sometimes also contributing authors to the reports or are they bureaucrats, and if the latter then what is their expertise and their potential bias, although the latter is somewhat redundant as noted in the previous paragraph?

The only IPCC-related consensus in favour of the theory of man-made warming comes from government representatives.

12 see http://mclean.ch/climate/IPCC_review_updated_analysis.pdf

4. The IPCC's weak evidence for a human influence

The IPCC contends that a significant human influence on climate is proven by four pieces of evidence but each of those can be shown to be very weak:

(a) The world is warming and the temperature increase is widespread

but... - How accurate are those temperatures? Later in this document it will be shown that the key dataset contains numerous flaws.

- The Earth has certainly warmed and cooled on previous occasions, sometimes for reasons that are expressed more as plausible hypotheses than solid facts. The fact that temperatures have risen since 1975 is not proof that human activity is responsible.

(b) The temperature increase cannot be explained by internal variability or heat moving from one climate component to another

but... - It is widely accepted, even by the IPCC, that the 1998 temperature spike was due to a strong El Nino in the Pacific. The IPCC regards El Nino events as "internal variability" so it is either contradicting itself when it claims that internal variability cannot account for warming or it is deliberately ignoring extended periods that were close to El Nino (or La Nina) events but failed to cross the arbitrary threshold into those conditions.

- Does the IPCC use the term internal variability for climate influences that are poorly understood or does it sometimes and selectively regard the ENSO system as something else? And if it has a confused perception of ENSO then what else does it not understand about climate?

(c) The distribution of warming is not consistent with models

but... - There is no evidence whatsoever that the models are accurate and complete. This seems highly unlikely given that the IPCC said in 2001 that the level of scientific understanding of 7 out of 11 climate factors was poor or very poor, and said the same in 2007 about 5 of 8 radiative factors (as a subset of all climate factors). How can accurate models be created when the scientific understanding of many factors is low? Are there factors that have not even been fully recognised?

- Even IPCC coordinating lead author Kevin Trenberth has said that the models are not accurate (see below) and by doing so he joined a host of other voices saying the same thing.

- A consensus of models, such as the IPCC presents, is worthless. At most only one model will ever be correct but its output would be lost among the output of incorrect models. All models are very likely to make similar assumptions especially when modeling situations that are described only by very few research papers. An incomplete and immature science like climatology is not settled by any kind of vote, which is what a consensus really is.

- How well is this distribution of warming understood? Scientists still argue about the existence of the Ferrell Cell circulation as a possible mid-latitude bridge between the Hadley Cell circulation and the polar circulation but the recent prevailing opinion is that it doesn't exist. If scientists are arguing about major circulation components then less significant circulation components might be at an even lower level of certainty. It is impossible to create accurate models if the basis for those models is poorly understood.

(d) Climate models need to include an anthropogenic (i.e. "human") component in order for the output to match the observed surface temperatures

but... Where is the proof that climate models are accurate and complete for circumstances without any possible anthropogenic component? There is none. Below it is shown that the average of 23 climate models cannot accurately replicate twentieth century temperatures, not even those prior to 1975, which is the start of the period over which the IPCC claims a significant human influence on temperature.

- The symptoms for which an anthropogenic input are claimed to be required may be nothing more than a deficiency in the models. Climate models are "tweaked" (i.e. some of several hundred parameters are adjusted) to make them closely match the results of observational data. Tweaking a component related to human activity is far easier than admitting that important factors may be poorly described in the model and setting out to correct them.

- This assumes climate models to be an accurate and complete representation of every possible climate factor. That is patently absurd when organisations like NASA continue to publish new findings about aspects of climate and the solar system.

How accurate are the IPCC's climate models?

In a posting to a weblog operated by "Nature" on 4 June 2007 Trenberth[13] said (in part)

> None of the models used by IPCC are initialized to the observed state and none of the climate states in the models correspond even remotely to the current observed climate. In particular, the state of the oceans, sea ice, and soil moisture has no relationship to the observed state at any recent time in any of the IPCC models. There is neither an El Niño sequence nor any Pacific Decadal Oscillation that replicates the recent past; yet these are critical modes of variability that affect Pacific rim countries and beyond. The Atlantic Multidecadal Oscillation, that may depend on the thermohaline circulation and thus ocean currents in the Atlantic, is not set up to match today's state, but it is a critical component of the Atlantic hurricanes and it undoubtedly affects forecasts for the next decade from Brazil to Europe. Moreover, the starting climate state in several of the models may depart significantly from the real climate owing to model errors ..."
>
> "The current projection method works to the extent it does because it utilizes differences from one time to another and the main model bias and systematic errors are thereby subtracted out. This assumes linearity. It works for global forced variations, but it can not work for many aspects of climate, especially those related to the water cycle. For instance, if the

13 See http://blogs.nature.com/climatefeedback/2007/06/predictions_of_climate.html

> current state is one of drought then it is unlikely to get drier, but unrealistic model states and model biases can easily violate such constraints and project drier conditions. Of course one can initialize a climate model, but a biased model will immediately drift back to the model climate and the predicted trends will then be wrong. Therefore the problem of overcoming this shortcoming, and facing up to initializing climate models means not only obtaining sufficient reliable observations of all aspects of the climate system, but also overcoming model biases. So this is a major challenge."

So even a lead author of chapter 3 of the IPCC's Fourth Assessment report is acknowledging fundamental flaws in models.

In presentations related to this Garnaut Climate Change Review both Pearman and Power included graph SPM-5 of the Summary for Policymakers to the IPCC 4AR Working Group I report, which is a copy of Figure 10.4 of the WG I report.

This graph is intended to show the predicted temperatures under different scenarios of greenhouse gas emissions forward from year 2000 and in order to provide context it includes a simulation of historical temperatures from 1900 to 2000.

The data for the graph across 1900-2000 is the average of 23 different climate models. When shown in the IPCC Fourth Assessment report it included a shaded area either side of the line to indicate ±1 standard deviation range of individual model annual means.

Figure 4-1 shows the portion of graph SPM-5 that contains the simulation of the twentieth century and Figure 4-2 a graph of what should be matching data - the annual average temperatures according to dataset HadCRUT3v re-based to the period 1980-99 instead of the usual 1961-90.

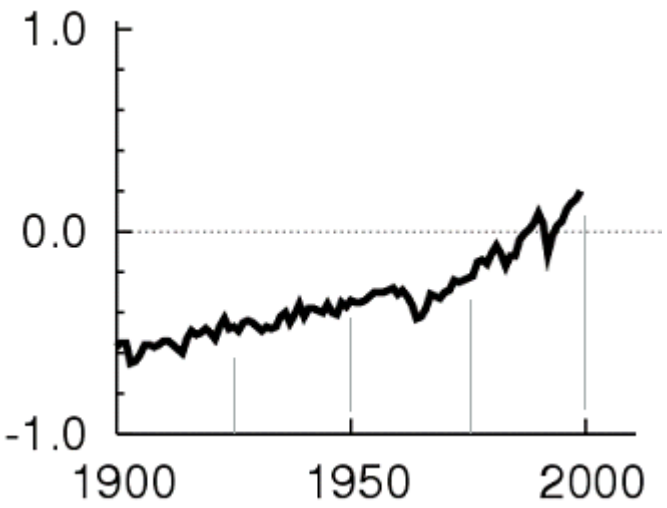

Figure 4-1. Estimated historical annual average temperature anomalies according to 23 climate models (part figure SPM-5 of IPCC WG I report)

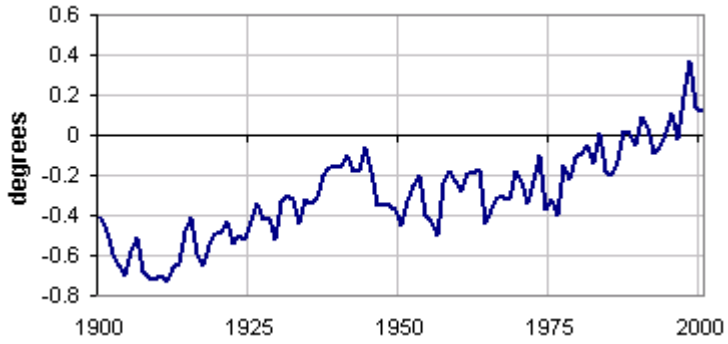

Figure 4-2. Annual average temperatures according to CRU data (0 line = average 1980-99)

If the models were accurate then these graphs should be almost identical for at least a substantial part of the period, but they are not.

The output from the model clearly fails to match the observational data according to the CRU. The low point around 1910 is missing from Figure 4-1 and so are the peak of 1945, the fall to 1950, the relatively constant period to 1975, the peak of 1998 and the fall to year 2000.

Figure 4-1 represents the average output of 23 supposedly accurate models but clearly these models are incapable of anything approaching accurate prediction of historical temperature patterns. There is simply no reason to assume that these models produce credible output for any interval in the past or the future.

The IPCC's so-called evidence is inadequate to irrefutably prove that human activity has significantly influenced temperatures over the last 30 years (i.e. since 1975).

5. The CSIRO's claims

The CSIRO has a reputation for its climate reports but as I showed in my detailed analysis[14] that reputation is not greatly deserved fro several reasons:

(a) The impact of the El Nino–Southern Oscillation (ENSO) is typically played down or ignored, but omitting the data across the time of major ENSO events produces substantially different trends.

(b) Other climate influences such as cloud cover, wind speed and wind direction are likewise ignored despite all having a substantial impact on temperatures.

(c) The climate models used in these reports appear to be "tweaked" (i.e. some of the many parameters adjusted) in order to try to match historical meteorological observations and those that achieve a close match are claimed to be accurate. Such a claim is false unless the models can be proven to accurately include every climate factor, and yet climate scientists agree that the level of understanding of many factors is low.

(d) A characteristic of many of these reports was the great difficulty the reader had in comparing the historical observational data (typically back to 1950) with the output from computer models that attempted to predict the conditions across that period. In one instance the vertical axis on one of a pair of corresponding graphs did not match but a casual glance would assume a close match.

The CSIRO's thinking is well illustrated by the report "Climate Change in Australia: Technical Report 2007" (hereafter "CCA report") that it co-authored with the Australian Bureau of Meteorology.

Chapter 2 of the CCA report discusses the historical climate and related environmental issues such as sea level but notably omits any mention of cloud cover and the influence of wind (both speed and direction).

The former is known to have varied over time and it obviously directly influences temperature through the blockage of radiation.

The "official" mean monthly temperature is calculated as the arithmetic average of the daily mean maximum and the mean minimum temperatures. (This means that the mean temperature is not in fact an average of the temperatures recorded at regular time intervals - and I illustrate the impact of this difference in my review of this CCA report[15]). Just a small change in cloud cover can impact the daily maximum and minimum temperature recorded in any 24-hour period, and consequently in the official monthly mean temperature.

Winds very clearly influence the recorded temperatures. In my review of the CCA report I showed that according to data from Laverton, on Melbourne's south-western outskirts, last summer (2006-07) had 11 days with maximum temperature greater than 35 degrees. After applying a filter to exclude days with predominantly strong winds from the north the number of hot days fell to just 3.

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14 McLean, J.D. (2006) "A Critical Review of Some Recent Australian Regional Climate Reports", *Energy and Environment*, vol. 17, no 1 (March 2006). (Available online via http://www.mclean.ch/climate/global warming.htm)

15 http://mclean.ch/climate/CCA_review.pdf

Residents of Melbourne were reminded of the influence of wind in the last week of December 2007 and the first few weeks of 2008 when hot northerly winds sent temperatures into the 40's, and in the case of Perth it was winds from the east or northeast.

Another way to examine the impact of wind is to consider the relationship between wind direction and temperature. One approach is to aggregate the temperature for each compass point.

Figure 5-1 shows this for the wind data at 3pm from Laverton in December 2006 and 2007. In this analysis intermediate compass points were consistently rounded in an anti-clockwise direction (e.g. NNE became N) and it was found that average temperatures at each point were virtually identical in each year.

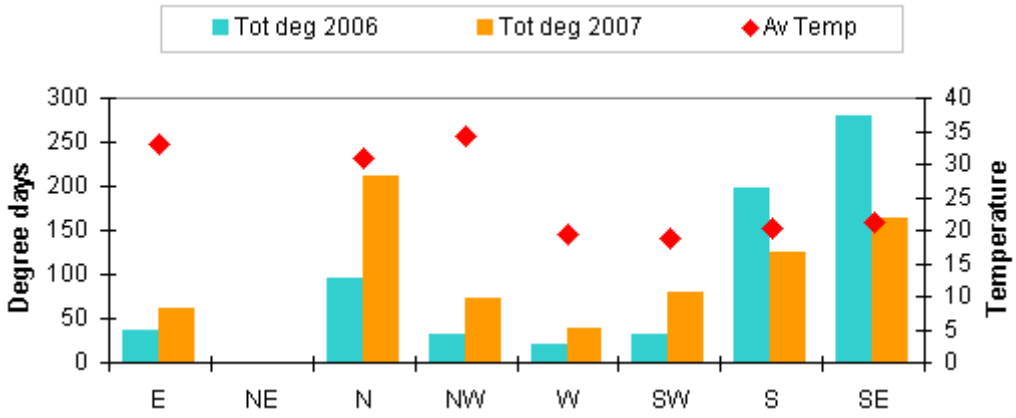

Figure 5-1. Aggregate degrees from each compass point for Laverton (Vic) in December 2006 and 2007.

The average 3pm temperatures were 22.33°C and 24.35°C and the total degree-days 692.3 and 754.7 in 2006 and 2007 respectively. The greater contribution of warmer northerly winds and lesser contribution of cooler southeasterly winds in 2007 was probably a major driver of those higher temperatures.

Chapter 2 of the CCA report included a map to indicate the rainfall trends from 1950 to 2006 but play down the fact that the 1950s were exceptionally wet in eastern Australia and this boosted the Australia-wide average. The rainfall in eastern Australia during 1950 remains the maximum annual figure on record. Substantial rainfall occurred again in the mid 1970s, so no wonder that the recent reversion to levels close to the 50-year average from 1900 to 1949 has caused a decreasing trend.

In a similar the map showing the temperature trend from 1950 to 2006 is distorted by Australia having its the third lowest annual average mean temperature on record in 1956, only beaten by two earlier years.

Both the rainfall and temperature maps appear to be optimised to paint a gloomy picture. Trend maps based on data of just 50 years (1957 to 2006) rather than the odd 57 years would have told a different story, but the selection of a start date has always been a key to finding a climate trend that illustrates a point.

Chapter 2 also claims that sea levels around Australia rose an average of 1.2mm/year from 1920 to year 2000. It is rather more coy about saying that this rate of change is based on synthesised data rather than monitoring. Only 5 tidal stations were reporting data in 1950 and only two prior to 1940.

The synthesising is based on establishing a relationship between recorded sea level and atmospheric conditions in recent times and using then to estimate sea levels from historical atmospheric conditions.

The technique makes the assumption that every possible influence on sea level and every interaction between those factors are accurately described. In the absence of proof that this assumption is well-founded we must take the position that the technique produces nothing more than an estimate, which means that the CCA report is expressing a certainty that simply does not exists.

Also in chapter 2 of the report we are told...

> **on rainfall -**
> "Australian rainfall shows considerable variability from year-to-year, partly in association with the El Nino – Southern Oscillation (ENSO)" (*pg 19*)
>
> **on tropical cyclones -**
> "... although there have been apparent decreases in [tropical cyclones] in east Australian numbers since the 1970s largely due to increasing numbers of El Ninos" (*pg 22*)
>
> **on east coast low pressure cells -**
> "... showed significant correlation between the occurrence of east coast lows, the Southern Oscillation Index, and the latitudinal position of the subtropical high pressure belt. There is a strong tendency for east coast lows to occur after El Nino years and in particular when an El Nino is followed by a La Nina". (*pg 23*)
>
> **on sea surface temperature -**
> "In the Pacific, an El Nino-like pattern features prominently in the warming trend with stronger warming [of the sea surface] in the eastern Pacific. ... It is not clear whether the pattern is related to greenhouse gas induced warming, or is caused by the fact that since the mid-1970s, natural variability has resulted in there being more El Nino years than la Nina years." (*pg 25*)
>
> **on ocean currents -**
> "The [Leeuwin] current is stronger during a La Nina year and weaker during an El Nino year. ... Since the mid-1970s there have been more El Nino than La Nina events" (*pg 25*)
>
> **on sea level -**
> The CSIRO report uses synthesised historical data in its graphs and while it makes no direct reference to ENSO the paper that it cites (Church, 2006[16]) certainly does – "*There are suggestions in both the Australian mean time-series and in a number of the of the individual records (e.g. Fremantle) that the rate of sea level rise was at a minimum from the mid-1970s to the mid 1990s. This minimum occurs during the periods of more frequent, persistent and intense ENSO events, as evidenced by the SOI since the mid-1970s. ... ENSO events significantly affect sea level along the west Australian coast.*"

16 Church, J.A., J.R. Hunter, K.L. McInnes, N.J. White (2006) - Sea-level rise around the Australian coastline and the changing frequency of extreme sea-level events" Australian Meteorological Magazine, 55, 253-260

It would seem that the authors of the CCA report recognise that the ENSO is a powerful influence on Australia's climate. How odd then that the entire discussion of ENSO consists of just four brief paragraphs and four graphs.

How odd too that no mention is made of the Great Pacific Climate Shift of 1976 despite that shift marking a watershed regards ENSO tendencies and being the primary cause of the often-mention variation since the mid-1970s. (see also section 6)

In chapter 3 the CCA report ignores this very critical shift in ENSO activity in 1976 and simply asserts, without any evidence whatsoever, that mankind has been responsible for the variation in Australia's climate over the last 50 years.

The report essentially repeats the assertions and weak claims made by the IPCC before proceeding to use the output of unproven climate models to make predictions.

In previous CSIRO climate report (largely unsuccessful) attempts have been made to show that the output of climate models matches historical climate data. This time there is no comparison and the reader is clearly expected to assume that the models are accurate and credible.

We are even instructed to ignore natural climate variability and rely on models, viz:

> "Accurate estimation of natural variability based on observations is difficult. It is instructive to consider the variability simulated by the CSIRO Mark 3.5 climate model, in an 1100-year simulation for steady, pre-industrial conditions." (*pg 56*)

It would seem that the report is fixed on removing any possible natural influence on climate in order to gloss over the absence of evidence of any significant human influence.

One must conclude that the absence of any evidence in the "Climate Change Australia" report indicates that neither the CSIRO nor the Australian Bureau of Meteorology can support their assertion of man-made warming.

The CSIRO has not in any of its climate reports, including the CCA report, presented clear evidence of a significant and irrefutable human influence on Australia's climate.

6. Key global climate issues

Several climate issues that are underplayed by the IPCC report or entirely absent are very important to the understanding of climate change and generally work against the possibility of a human influence on climate.

In this section we will look at global or other broad issues prior to focusing on Australian conditions in the next section.

6.1 The contribution of carbon dioxide to temperature

The MODTRAN software package is a widely accepted simulation of downward radiation (i.e. the "greenhouse" effect) caused by atmospheric carbon dioxide. Running this software produces the graph shown in Figure 6-1. The Y-axis indicates the downward radiation in Watts/m^2.

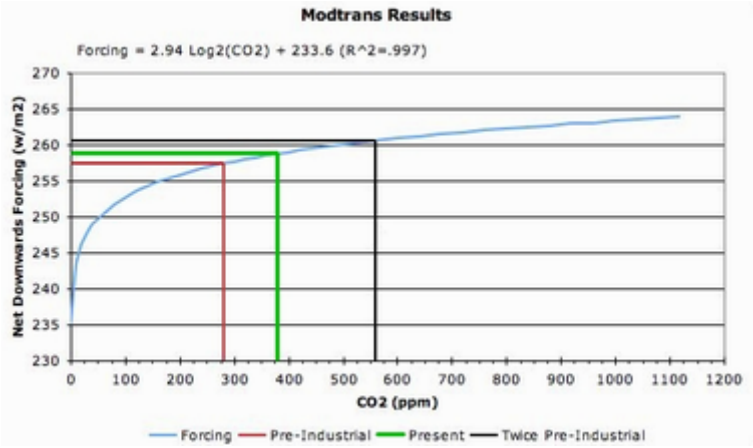

Figure 6-1. Downward radiation caused by carbon dioxide, according to MODTRAN software

Two features of the above graph are of notable interest.

According to this data the increase in atmospheric CO_2 from the generally accepted pre-industrial level of 280ppm to 325ppm should have caused more downward radiation (and therefore more warming) than the increase from 325ppm to 370ppm. According to temperature data from HadCRUT3v, GISS and NCDC global average temperatures did not rise in this manner.

An increase from 370ppm to 580ppm (i.e. to double the pre-industrial levels) will cause an increase in down-welling radiation of a very small 2 Watts/m^2. The conversion from these units into temperature – the value of the sensitivity factor - expressed as degrees/(W/m^2), is one of the hottest debates in climatology at the moment.

Estimates of the sensitivity factor range from 0.1 (Idso[17]) to more than 1.1 according to climate models, and that range includes an estimate by NASA's James Hansen (2003)[18] of between

17 Idso, S.B. (1998) CO_2-induced global warming: a skeptic's view of potential climate change, *Climate Research*, v10: p69-82 1998

18 Hansen, J (2003), Can we defuse the Global Warming Time Bomb?, *natural Science*, August 2003

0.5 and 1.0. The IPCC's Third Assessment Report (2001) showed a variety of values ranging from 1.5 to 4.5 and most Global Climate Models now adopt values in the range 0.25 to 0.8 [19].

The IPCC's 4AR Synthesis Report notes (in section 2.3) that a doubling of carbon dioxide is estimated to cause a likely temperature increase of between 2°C and 4.5°C. A doubling of CO_2 amounts to an addition 3.7 Watts/m2 so the IPCC's estimated temperatures translate to sensitivity factors in the range from 0.54 to 1.22.

Empirically determined factors, those derived from observational data, seem to be consistently lower than the factors required to "balance" the output of climate models against historical data.

What's more the factor will also depend on the amount of moisture available for evaporation from wet ground or vegetation. Latent heat used in evaporation or in the melting of snow and ice will make no contribution to temperature.

The range mentioned here only briefly shows a high value that is more than 40 times greater than the lowest estimate so the range of estimated temperatures will be vast. Depending on the value that one adopts the same set of data will produce an estimate of 8 degrees or 0.2 degrees.

Temperature predictions based on increasing concentrations of greenhouse gases have no credibility until the sensitivity factor that links watts to degrees is known to far greater precision. Conversely it is pointless to set emissions limits without having a clear idea of their impact on temperature.

6.2 Missing "fingerprint" in tropospheric & stratospheric temperatures

The IPCC[20] and the US-based Climate Change Science Program (CCSP)[21] show the expected signature of warming caused by greenhouse gases (Figures 6-2a and b).

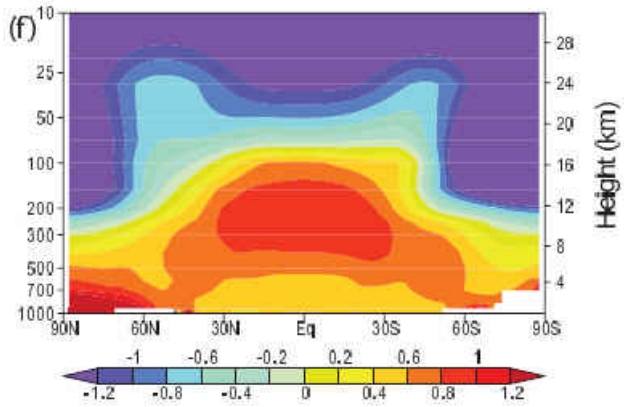

Figure 6-2a. Predicted temperatures trends in the lower troposphere according to the IPCC (period=1890-1999)

19 For more discussion see http://junkscience.com/Greenhouse/What_watt.html (accessed Jan 2008)
20 IPCC Fourth Assessment Report, Working Group I report, chap 9, pg 679
21 CCSP Synthesis and Assessment Product 1.1 (Apr 2006), chap 1, pg 25

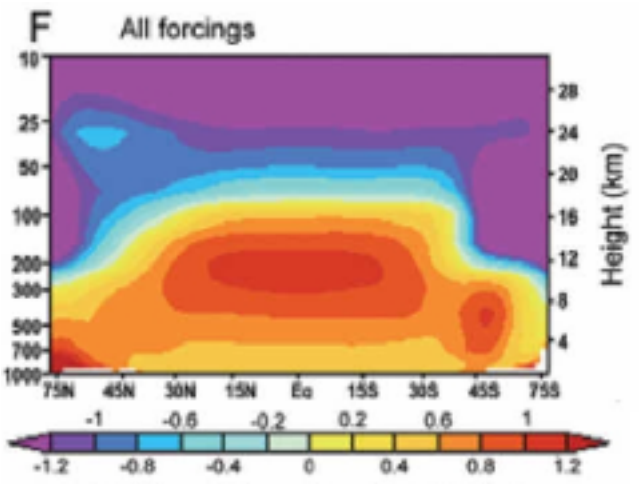

Figure 6-2b. Predicted temperatures trends in the lower troposphere according to the US CCSP (period=1958-1999)

The "fingerprint" predicted by figures 6-2a and 6-2b is missing from the observed trends in lower tropospheric temperatures as noted in the CCSP Report[22] (see Figure 6-3).

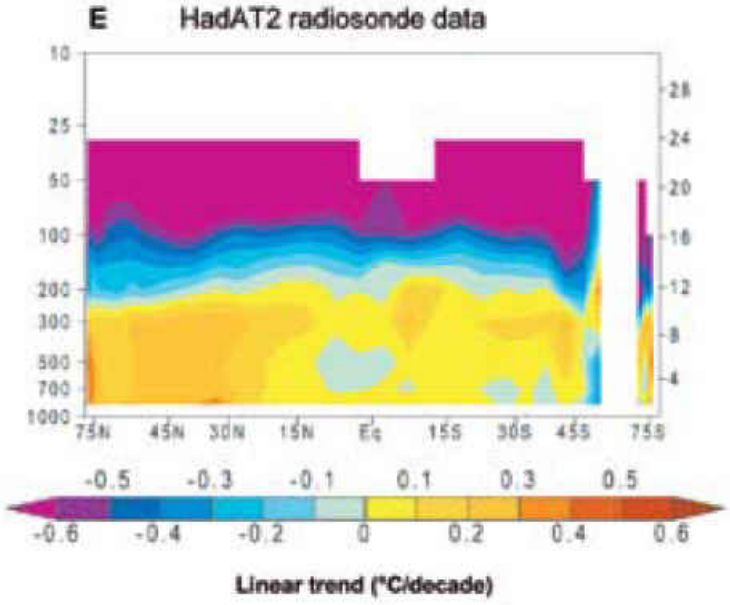

Figure 6-3. Trends in lower tropospheric temperatures according to HadAT2 dataset. (Note that the scale is different to figure 6-2)

In fact the observed trends in lower tropospheric temperature are quite different to the predicted trends.

- the increase between latitudes 30N and 30S is lower (peaking at about 0.2 degrees),
- the spread across all latitudes is more consistent, and
- cooling of 0.6C or more takes place at about 16km rather than about 22km.

22 ditto chap 5, pg 116

What's more, according to Douglas et al (2007)[23] the predicted tropical temperature trends of an ensemble of 22 models are clearly different to the observed lower tropospheric temperatures (see Figure 6-4).

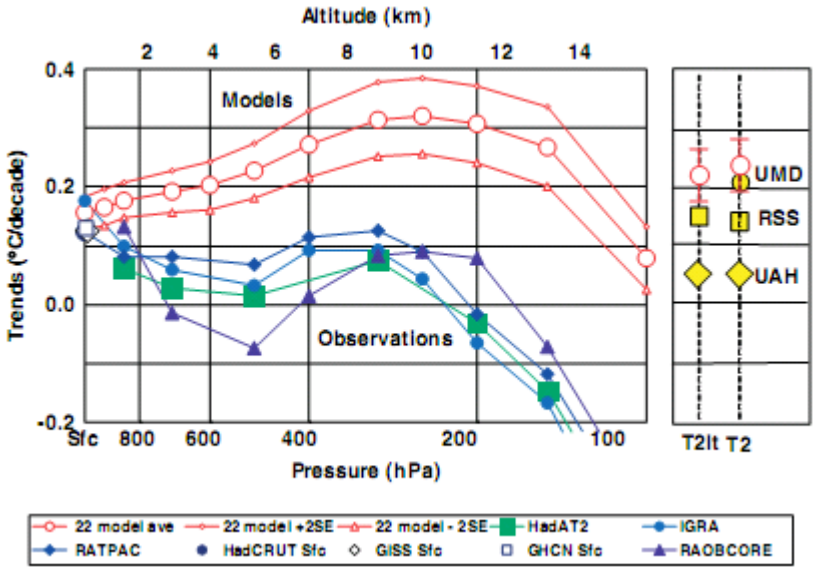

Figure 6-4. Predicted and observed trends for lower tropospheric temperatures

The temperatures predicted by models that assume a substantial influence of carbon dioxide are failing to materialise. This suggests that fundamental errors exist within the models and that the assumption could be wrong or overstated.

6.3 Accuracy of HadCRUT3v global temperatures[24]

The IPCC's Fourth Assessment report relied very heavily on temperature data from the HadCRUT3v dataset, which is a product of the UK's Hadley Research Centre and Climatic Research Units. The critical nature of this data surely warrants detailed verification or independent auditing but no such action has ever been undertaken - or perhaps more accurately, has never been permitted.

In contrast the much shorter data record determined by satellite-based microwave sounder units (MSUs), a record that some might perceive as a threat to the dominance of the HadCRUT3v dataset, has been subjected to independent audit on more than one occasion.

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23 Douglass, D.H, J.R. Christy, B.D.Pearson and S.F.Singer (2007) A Comparison of Tropical Temperature trends with Model Predictions, International Journal of Climatology, DOI: 10.1002/joc.1651

24 The information in this section comes from my forthcoming paper, to be submitted in late January 2008, and from Brohan, P., J.J. Kennedy, I. Harris, S.F.B. Tett and P.D. Jones, 2006: Uncertainty estimates in regional and global observed temperature changes: a new dataset from 1850. *J. Geophysical Research* **111**, D12106, doi:10.1029/2005JD006548 and online at http://www.cru.uea.ac.uk/cru/data/temperature/HadCRUT3_accepted.pdf

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The HadCRUT3v dataset applies a grid system across the Earth's surface - most commonly 5 degrees latitude by 5 degrees longitude - and uses the data from meteorological observation stations within each grid cell to determine the average temperature for that cell. (As part of the validity checks if the data from any station is more than 5 standard deviations from the average that data is removed and the average recalculated.) To determine global average temperatures the data in each grid cell is weighted by the cosine of the latitude of the centre of the cell in order to account for the Earth's spherical shape.

One obstacle to an audit of HadCRUT3v is that the CRU has said on several occasions that it has no record of the observation stations used to determine the average temperatures for any particular month. Put that with the variation over time of the coverage of the data, i.e. the number of grid cells with data from observation stations (see Figure 6-5), and it is clear that the data sources for calculating the average global temperature are constantly changing.

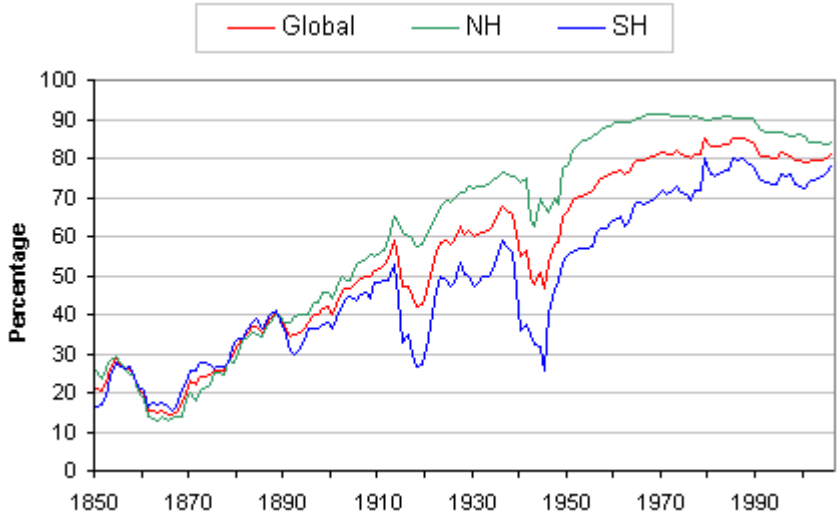

Figure 6-5. Coverage of the HadCRUT3v temperature data (hemispheric and global)

The mapping of observation stations to grid cells in any month of any year is impossible because the CRU provides only a list of stations and their locations but with no information about the period for which data was available. Taking a "best-case" scenario by assuming that all listed stations operate in the same month it can be shown that for the 905 grid cells (5 lat. x 5 long.) that consist mainly or entirely of land regions:

Cells with 0 stations	360	39.8% of total
Cells with 1 station	157	17.4% of total
Cells with 2 stations	110	12.2% of total
Cells with >2 stations	278	30.6% of total

Cells with just 1 or 2 stations, which comprise almost 30% of the above "best case", create problems for determining the average temperature within any cell because it is not possible to take the mean value of multiple stations and reject extreme values, Comparisons are supposedly made with adjacent cells but the data shows good reason to question the thoroughness of that check.

Table 6-1 shows some examples of HadCRUTv3 gridded data where the value in the centre cell varies dramatically from the surrounding cells. (Left group: lat 55-60N, long 100-105E,Jan 1981; centre group: lat 40-45N, long 55-60E, Dec 1993; right group: lat 55-60N, long 60-65E, Nov 1958)

4.371	6.340	5.157	-1.827	-4.251	-6.303	1.202	3.440	2.007
-0.420	**-9.075**	0.212	-1.426	**-12.890**	-3.657	0.931	**10.320**	2.033
-1.259	-1.082	-1.465	-0.048	0.408	-1.657	0.059	1.520	2.415

Table 6-1. Grid cells that show significant difference to their surrounding cells.

The extent of the above problem varies according to what one deems to be acceptable limits of variation but the implication is that the comparison of cell values is highly suspect. When the increase in global average temperature since 1975 is in the order of 0.8 degrees even a consistent small discrepancy in the grid cell values could make a substantial difference.

The gridded data also shows inconsistencies over time in the relationship of values from adjacent cells. Figure 6-6 shows the temperature anomaly from 3 adjacent cells, all over land in China. The only logical explanations are that an observation station was either moved to a new site, or its immediate physical environment was substantially altered, or a station closed down and a new one started operation.

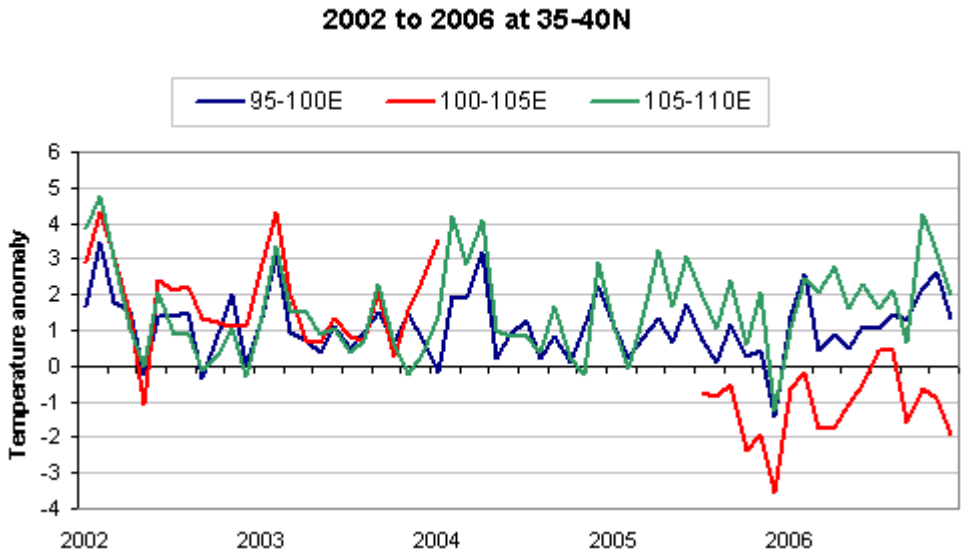

Figure 6-6. HadCRUT3v temperature data from 3 adjacent grid cells

The data from observation stations is expressed as an anomaly (i.e. difference) from the long-term average. The common practice in climatology is that the long-term average is calculated from the temperatures across a 30-year period, usually taken as 1961-1990 inclusive.

The long-term average station temperatures for the HadCRUT3v dataset is 16 years anywhere between 1961 and 1990. According to this dataset global average temperatures started rising in 1976 so the long-term average for any station might fall in the cooler period and emphasise subsequent warming, or might fall in the period of rising temperatures and emphasise the earlier cooler periods.

Any data cell that is not flagged as "missing data" must obviously contain data calculated from one or more observation stations. If the number and location of these stations were consistent across the period of the long-term average then the average of the grid cells across that period would be zero (or very close to it given the accuracy of the data).

Only 20 of the 2592 grid cells in the HadCRUT3v contain data that averages close to zero in all 12 calendar months across all years for which data is available in the period from 1961 to 1990.

When no base value can be determined according to the CRU's requirements a long-term average supplied by the World Meteorological Organization is used but that data is questionable because so little is known about it. Perhaps it comes from a different time period or is somehow derived from other observations stations. Even the CRU acknowledges that the WMO is of lower quality.

The integrity and hence the validity of the HadCRUT3v dataset is compromised by relying on several thousand observation stations that are in a constant state of flux and are located in physical environments that change due to natural and man-made influences.

The temperature records from satellite-based instruments have problems of their own but these are conceptually far easier to deal with and the data should be more reliable. Of course this would diminish the value of historical temperature records prior to the introduction of satellites but if that earlier data is wrong then it is of no value anyway.

6.4 Variations in sea level

The IPCC claims that sea level rose at an average rate of 1.8mm/year from 1961 to 2003 and at 3.1mm/year from 1993 to 2003. Those figures look very suspicious for two reasons. The resultant average from 1961 to 1993 is just 1.33mm/year and satellite-based monitoring replaced tidal gauges in 1993, the point at which sea level apparently started to rise sharply.

An alternative source for sea level data is the International Union for Quaternary Research (INQUA). The INQUA Commission on Sea Level Change has monitored sea level for many years. Professor Nils-Axel Mörner was president of this commission from 1999-2003 and has worked in that area for more than 35 years. His work started with his 1969 thesis that was largely on the problem of determining variations in sea level. He introduced new theories about influences in sea level in the 1970s, 1980s and 1990s, and is the author of many papers and commentaries on the subject.

In contrast to the IPCC's reliance on models and synthesised historical sea levels (see section 5) Mörner and his team get out in the field and example the local environments for evidence of sea level change, particularly changes in high tide marks and shelving effect of storms or high winds.

Mörner led an INQUA project that made detailed on-site investigations in The Maldives[25] and established that the islands are under no threat from rising seas and that the trend over the last 2000 years is a decline, with each peak in sea level being smaller than the previous.

Figure 6-7[26] shows the monthly anomalies in sea level (base level is the average of all available data) for two sites in The Maldives (Gan, at latitude 0.4S and Malé at 4.1N). If any long-term trend exists it is a decrease from 1995 to 2002.

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25 Mörner, N-A., M. Tooley and G. Possnert, (2004), New perspectives for the future of The Maldives, Global Planet. Change, 40, 177-182

also Mörner, N-A (2004), The Maldives Project: a future free from sea level flooding Contemporary South Asia, 13(2), 149-155

also Mörner, N.-A., (2007) Sea Level Changes and Tsunamis. Environmental Stress and Migration over the Seas, Internationales Asienforum, vol 38(2007), no. 3-4. pp353-374

26 The figures in this section are based on data from the Permanent Service for Mean Sea Level operated by the Proudman Oceanographic Laboratory at the University of Liverpool (U.K.)

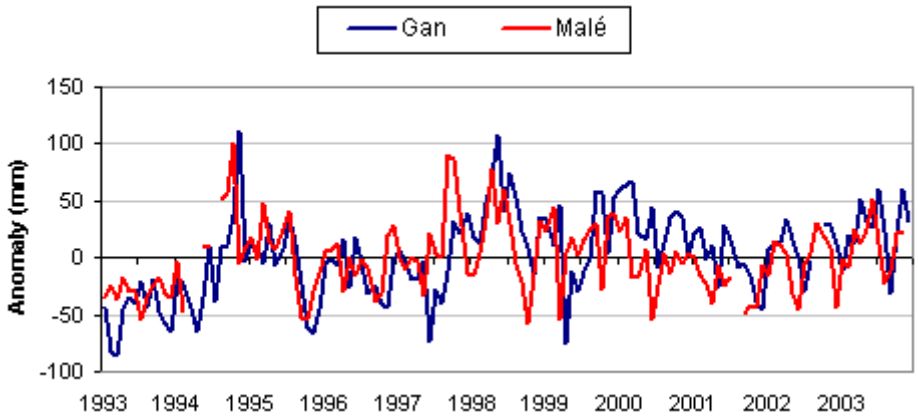

Figure 6-7: Monthly sea level anomaly for two locations in The Maldives

Mörner also reports that tidal gauges at Tuvalu show no trend towards rising seas. (This location is particularly relevant to any discussion that attempts to implicate Australia as a cause of rising seas in the South Pacific.)

The sea level around Tuvalu fluctuates around a base level. It falls during El Nino conditions and rises again when they have passed (see Figure 6-8)

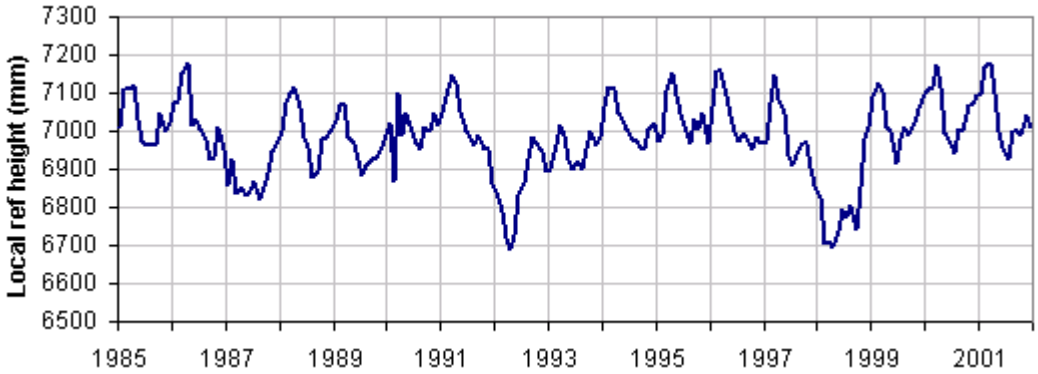

Figure 6-8: Sea level at Funafuti, located on one of the islands of Tuvalu.

Mörner has also questioned the claimed rise in sea level monitored by satellite by pointing out that the original TOPEX data showed no change in sea level until an attempt was made to calibrate the monitoring with data from tidal gauges. He says that the resultant introduction of an upward trend into what had been data with a zero trend looks suspiciously like the tidal gauges selected for the calibration were at one or more sites where the tidal gauge is sinking.

The IPCC predicts an increase in sea level of between 26cm and 59cm for a future scenario that continues today's use of fossil fuel and unchecked emissions.

These predictions are based on a chain of assumptions and predictions. Firstly they assume that the estimates of historical sea level are accurate, secondly that the satellite-based measurements are accurate, thirdly that the increase is due to heating rather than caused by the many other influences on sea level, and fourthly that anthropogenic emissions of carbon dioxide are largely responsible for recent warming.

If any one of these assumptions is wrong then the IPCC's predictions will have no credibility. Given that sustained higher temperatures - not warming but simply elevated - would have a similar effect due to heat penetrating into the ocean and various ice melting and contributing to sea level, those IPCC assumptions may indeed be wrong.

The IPCC's estimated increases in sea level based on 6 IPCC emissions scenarios are shown with the estimate from INQUA in Figure 6-9. Scenario A1F1 is the IPCC's continuation of current use of fossil fuel and unchecked emissions of carbon dioxide. The INQUA estimate assumes a similar situation to A1FI.

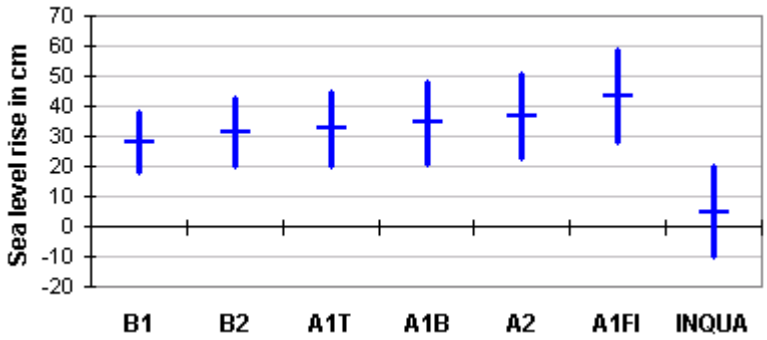

Figure 6-9. Estimated change in sea level by 2099 (range and mid-points). The first 6 from the IPCC and the last from INQUA

INQUA's experts that by year 2100 the increase in global average sea level will be between 5cm ± 15cm (i.e. between a fall of 10cm and a rise of 20cm), well below the IPCC's estimates.

6.5 The Great Pacific Climate Shift of 1976

During early 1976 the climate of the Pacific Ocean underwent a substantial shift. The causes of this shift are not clear but they appear to have been abrupt and of great magnitude, factors which rule out the gradual increase in the concentration of atmospheric carbon dioxide and cast serious doubt on any human involvement of any kind.

Guilderson and Schrag (1998)[27] examined ocean water near the Galapagos Islands and identified a substantial change in the amount of carbon-14 in the water from which they concluded that a massive reduction in deep water upwelling had occurred.

McPhaden and Zhang (2002)[28] took this further and estimated that the upwelling in the tropical Pacific decreased by about 25%, from 47 sverdrups[29] in the1970s to 35 sverdrups in the 1990s.

27 Guilderson, T.P and D.P. Schrag (1998), "Abrupt Shift in Subsurface Temperatures in the Tropical Pacific Associated with Changes in El Nino", *Science* 281, 240 (1998); DOI: 10.1126/ science. 281.5374.240

28 McPhaden, M.J. and D. Zhang (2002), "Slowdown of the Meridional Overturning Circulation in the upper Pacific Ocean", *Nature, 415*(7), 603–608 (2002).

29 1 sverdrup = 1 million cubic metres/second

That reduction in cold water upwelling is highly significant because it previously cooled the ocean. With less upwelling it is to be expected that El Nino conditions would be more common and La Nina to be less common, and this is borne out by the relevant data.

The Southern Oscillation is not a three-state entity of La Nina, neutral and El Nino conditions but a range of conditions for which a sustained period at one end of the range is called La Nina and a sustained period at the other is El Nino.

Figure 6-10 shows the annual average Southern Oscillation Index from 1950 to 2006 and it is obvious that negative SOI values (i.e. towards El Nino) of varying strengths dominate since 1976.

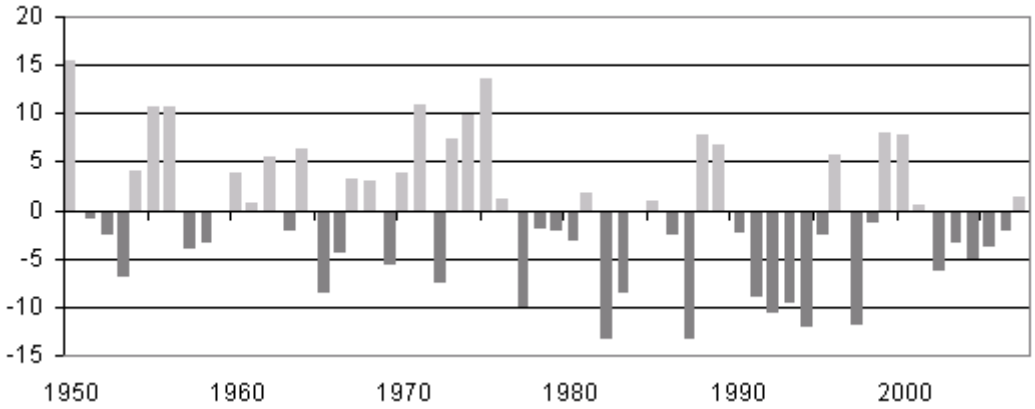

Figure 6-10. Annual average Southern Oscillation Index (1950 - 2006)

Another way to examine this change is by aggregating the SOI values. This technique is used because the index is centred on zero and so any important turning points in SOI values will be quite obvious.

Figure 6-11 is a graph of the aggregate SOI since 1950 (variously called the "accumulated difference" or the "integration"). The turning point corresponding to the Great Pacific Climate Shift is clear.

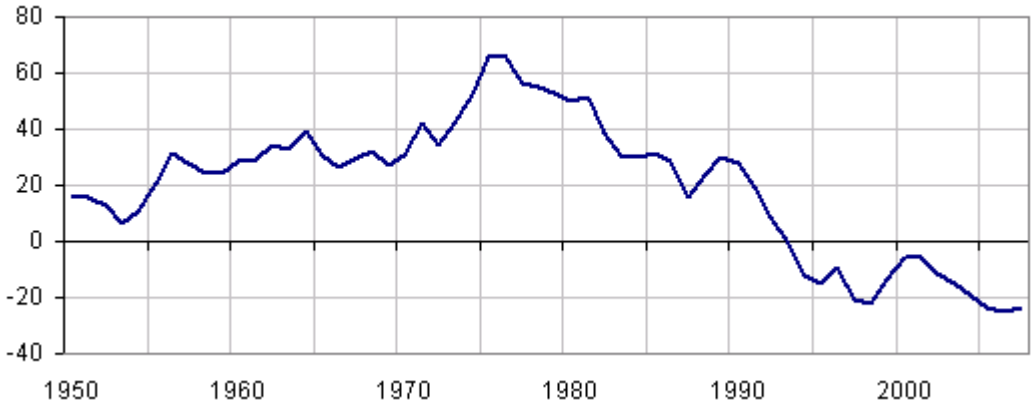

Figure 6-11. Aggregated average annual SOI values

This shift in the SOI is consistent with the findings of Vecchi and Soden (2007)[30] that the Walker Circulation, a west-east transfer of air at upper levels across the Pacific, has weakened over time. El Nino events cause air to rise in the central Pacific and move northward within the Hadley cell circulation, and this condition has become more dominant.

The aggregated global annual average temperature anomalies (Figure 6-12), based on HadCRUT3v data because few other sources exist, show substantial but inverted correlation to Figure 6-11.

The delay in fluctuations in Figure 6-12 is consistent with a short delay between the Southern Oscillation acting in the tropics and the dispersion of that heat to the rest of the Earth's surface.

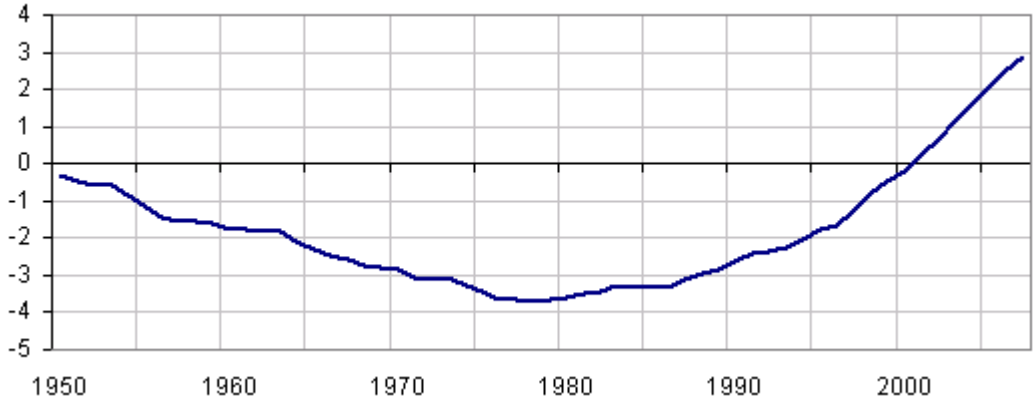

Figure 6-12. Aggregated Global temperature

The changes to the ENSO system resulting from the Great Pacific Climate Shift have far better synchronicity with the change in average global temperature than the steady increase in atmospheric carbon dioxide that has been observed since 1958.

This shift in SOI values is that the mean SOI now greatly favours the direction of El Nino conditions. Figure 6-13 shows the average annual SOI to 1975 for the 25 years from 1946 to 1970 and the average annual SOI from 1977 for the 25 from 1982 to 2006. The standard deviations were calculated in parallel with each of these averages.

The standard deviations about the pre- and post-shift means are very similar. That indicates that the pattern of variation in the SOI is not abnormal, only the shift. The average SOI across the 30 years 1946-1975 was +1.93 and across the 30 years 1977-2006 was -3.05, making a total shift of almost 5 points. For comparison purposes, a value of around -8 for 3 months is said to be an El Nino and around +8 for 3 months is a La Nina. If that 1945-1976 average became accepted as "normal" then the average SOI has more recently moved 50% of the way towards El Nino.

The other implication of the similar standard deviations is that the change appears to have taken place in some permanent or semi-permanent force rather than the variable forces that contribute to the irregular changes in the Southern Oscillation. This suggests that the "semi-El Nino" state will be permanent or at least long-term

30 Vecchi, G.A. and B.J. Soden (2007) Global Warming and the Weakening of Tropical Circulation, *Journal of Climate*, vol 20, DOI: 10.1175/JCL4258.1 pp 4316-4340

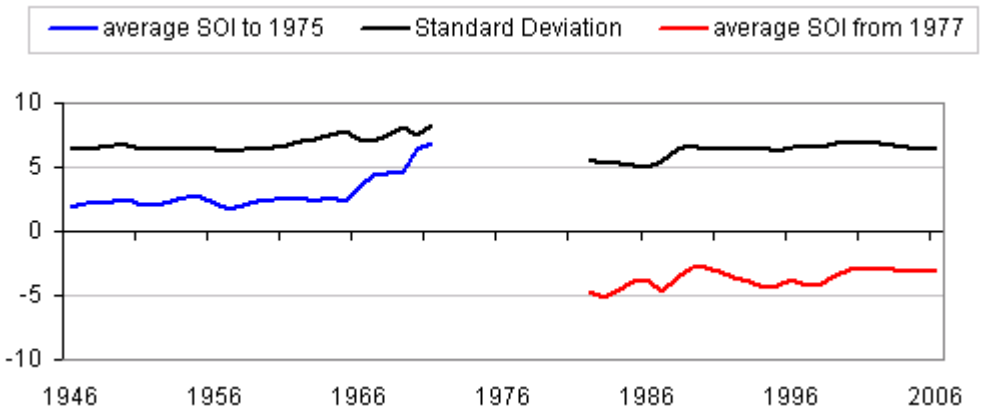

Figure 6-13. Average SOI to 1975 and from 1977, and standard deviation

The modified "semi-El Nino" state of the ENSO system that occurred as a result of the Great Pacific Climate Shift of 1976 will probably continue; it is difficult to predict otherwise while the cause of the shift is not clear. Continued warm temperatures and reduced rainfall are very likely for much of Australia.

7. Australia's changing climate and sea level

7.1 The overall picture of Australian climate change

Australian climate data is often shown as trends across certain periods of time and every element of climate treated as a somehow separate entity.

One approach is to use trend periods with little regard to the typicality of the early part of that trend and a failure to recognise that an atypical might skew a trend in a particular direction. Trends for Australia's rainfall and temperature trends often start from 1950 but just a few years later, in 1955 and 56, average rainfall was exceptionally high and in 1956 the mean temperatures was unusually low at 0.905 degrees below the 1961-90 average. No wonder trends starting at 1950 show sharply decreasing rainfall and sharply increasing temperatures.

A trend might also be influenced by strong natural events, for example El Nino events (as noted in chapter 5) but often there is an implication that a single dominant force, in particular human activity, is somehow the consistent driver of the entire trend.

Long-term trends are often shown without any attempt to break them into phases but it is the phases that are the key to observing certain shifts and to determining the likely causes of those shifts.

Using the same technique of aggregation shown in section 6, some key elements in Australia's climate are shown in Figure 7-1.

In this graph "temperature" is the annual average mean temperature, "DTR" is the diurnal temperature range (i.e. anomaly of maximum temperature minus anomaly of minimum temperature), "SST" is the sea surface temperature around Australia, SOI is the Southern Oscillation Index (which is a key indicator of ENSO conditions) and "rainfall anomaly" is the average rainfall in the given year minus the average rainfall across 1961-90. These values are scaled to fit within the same space because the values are less important than the turning points.

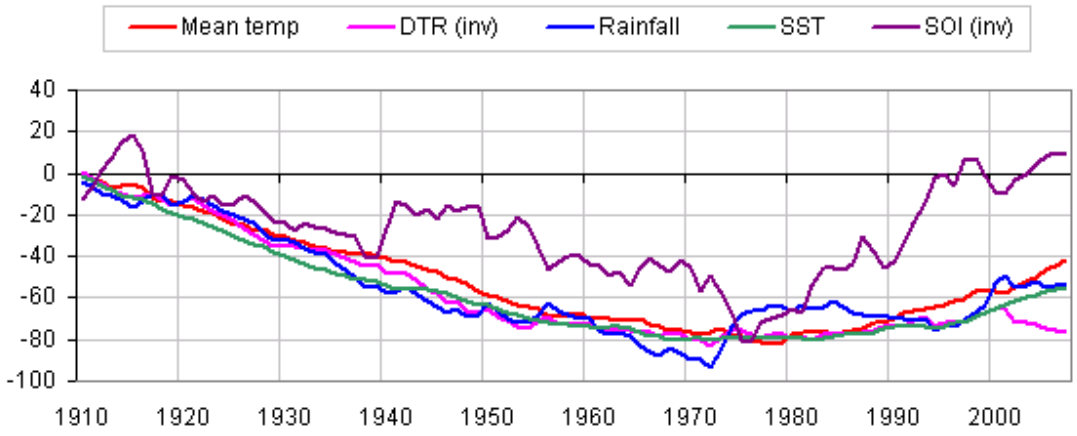

Figure 7-1. Aggregated values of annual averages of key climate factors

The relatively stable climatic period from 1910 to 1950 - although why it was stable is itself an interesting question - was suddenly disrupted during the decade from 1971 to 1980 and every key indicator shifted into a phase that was predominantly different to what it had been. The ENSO system shifted towards an El Nino state (see also section 6), mean temperatures rose,

sea surface temperatures rose after some delay, the diurnal temperature range (DTR) rose and that means less cloud, and rainfall also rose.

In the context of current claims about man-made warming it seems entirely unlikely that the sudden shift in these factors in the space of one decade could have been substantially driven by human activities.

7.2 Australia's mean temperature

Australia's long-term mean temperature pattern is often illustrated by a graph with a single trend line across the entire period.

Given that section 7.1 showed a dramatic shift in climatic conditions at or about the time of The Great Pacific Climate Shift an alternative interpretation breaks the time period into phases prior to and following that shift, with a period of readjustment linking the two (see Figure 7-2)[31].

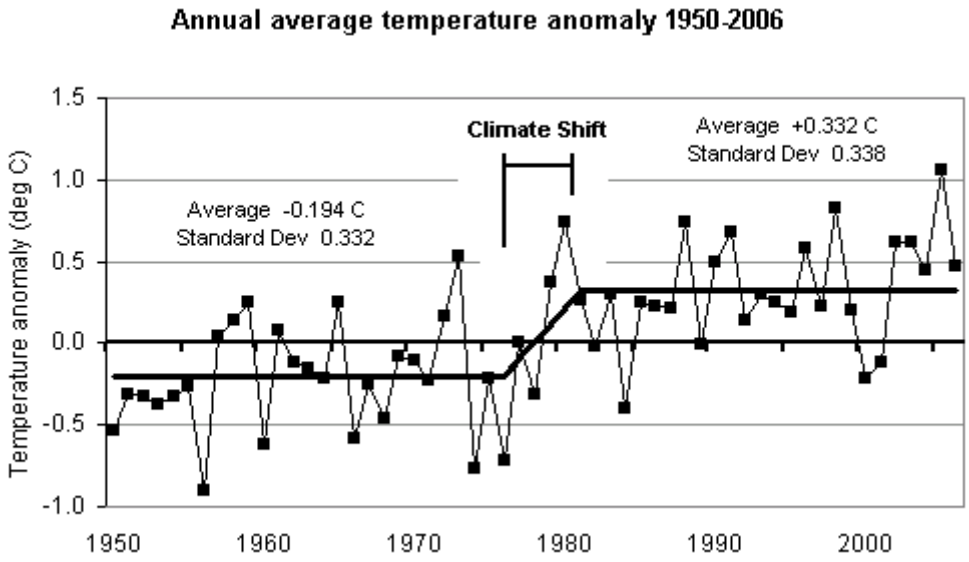

Figure 7-2. An alternative interpretation of Australia's mean temperature record

Over the 25 years from 1951 to 1975, which is the period before the climate shift, the average temperature anomaly across Australia was -0.194 ºC, i.e. 0.194 ºC below the 1961-1990 average. The standard deviation associated with these temperatures was 0.332 ºC and the standard error was 0.0664 ºC.

During the 25 years from 1981 to 2005, which is immediately after the climate shift, the average temperature anomaly was +0.315 ºC with a standard deviation of 0.338 ºC and a standard error of 0.0675 ºC.

In other words the two periods were statistically very similar except for the change in average temperature.

31 For more details see http://mclean.ch/climate/Aust_temps_alt_view.pdf

For the period 1950 to 1974 the temperature trend was an increase equivalent to 1.13 ºC/century and the trend from 1981 to 2005 was 1.66 ºC/century. The trend across the entire 1950-2005 period was also 1.66 ºC/century. The mathematical merger of the two trends across the two 25-year periods falls well short of the total trend, which means that a very substantial increasing trend is required across that 5 year period.

The temperature change between 1976 and 1980 was a huge 1.46 ºC, which is equivalent to a trend of 29.2 ºC/century, or more than 20 times the trends in the pre- and post-shift periods.

It is very highly unlikely that the substantial temperature shift across 1976-1980 could in any way be attributed to variations in carbon dioxide, especially when temperatures since 1980 have failed to show any comparable increase despite the increasing concentration of atmospheric carbon dioxide.

7.3 The relationship between ENSO conditions and temperature

As was noted in section 5, the report "Climate Change in Australia: technical report 2007" said that ENSO conditions influenced six key factors - rainfall, tropical cyclones, east coast low pressure cells, ocean currents, sea-surface temperature and sea level.

No mention is made of wind speed and direction but if east coast lows are affected then the winds that accompany those lows will also be impacted.

Temperature across the Australian land mass was also not mentioned as being under the influence of ENSO events, nor was the diurnal temperature range (DTR), but Figure 7-1 (above) shows a turning point in both of these values and in the SOI during the same decade as the Great Pacific Climate Shift, and the analysis in section 7.2 certainly hints at a link.

The relationship between the SOI, a measure of ENSO conditions, and temperatures can be explored using data for Eastern Australia supplied by the Bureau of Meteorology and cloud cover data extracted from the global records from the ISCCP[32].

The graphs of this analysis, shown below, use 6-month running averages to smooth short-term fluctuations and the correlation coefficients of the relationships are also noted. The scales on the right vertical axes are sometimes inverted to clarify the situation.

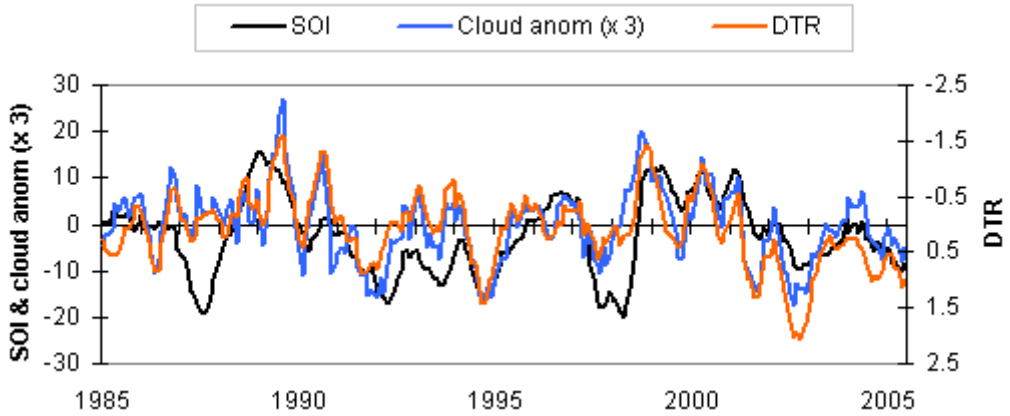

Figure 7-3a. Relationship between SOI, cloud cover and DTR

32 ISCCP = International Satellite Cloud Climatology Project, hosted by NASA (see http://isccp.giss.nasa.gov/)

Figure 7-3a shows the relationship between the SOI, DTR and the anomaly in cloud cover, where the anomaly is the difference between the extent of cloud in the current month minus the average for that month across the period of data (Jan 1984 - Jun 2005). In this graph the DTR is inverted. (Correlation coefficients: SOI to cloud = 0.533, Cloud to DTR = -0.836, SOI to DTR = -0.449)

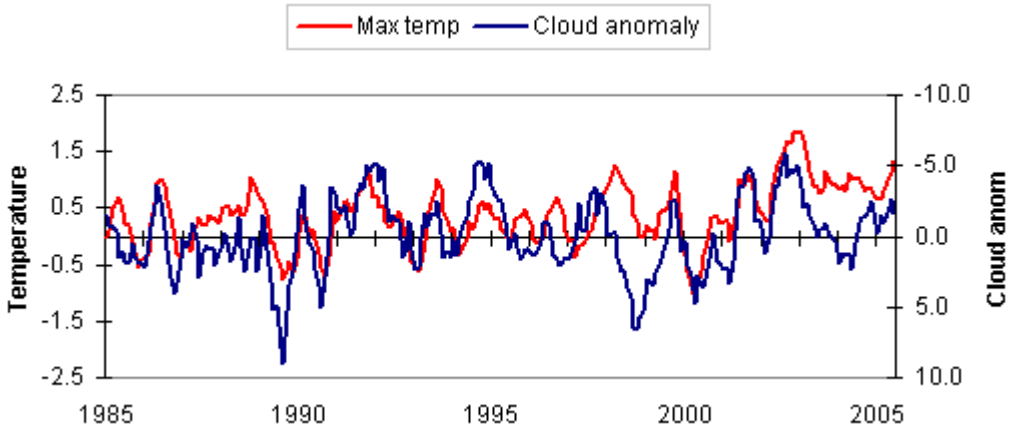

Figure 7-3b. Maximum temperature and inverted cloud cover

Figure 7-3b shows the relationship between the cloud cover anomaly (inverted) and the maximum temperature. A reduction in cloud cover means that more solar radiation reaches the earth's surface. This graphs shows that a close relationship existed for some periods but not for all. (Correlation coefficient: Tmax to cloud = -0.546)

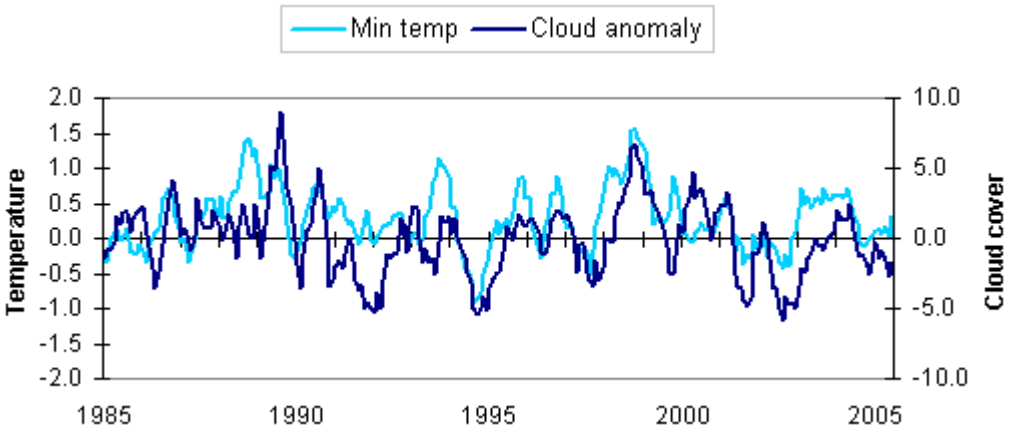

Figure 7-3c. Minimum temperature and cloud cover

Figure 7-3c shows the relationship between cloud and minimum temperature. An increase in cloud cover reduces nighttime cooling. Again the relationship is sometimes strong and sometimes weak. (Correlation coefficient: Tmin to cloud = 0.561)

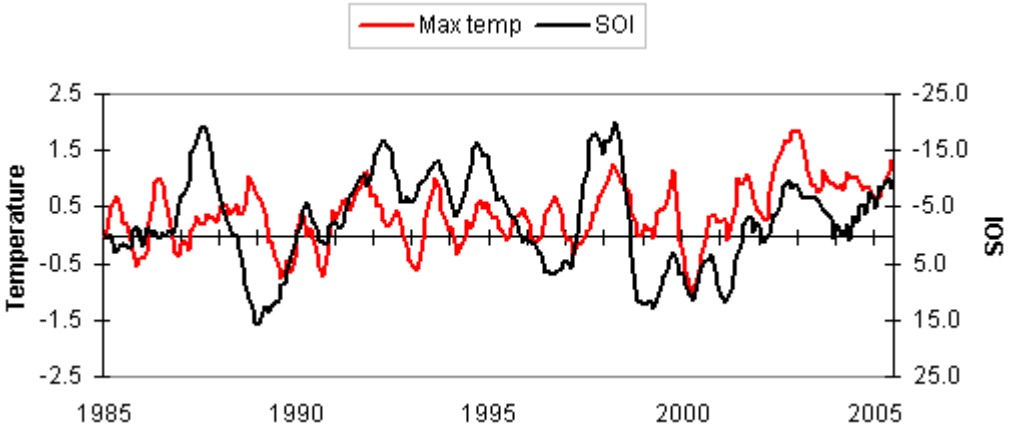

Figure 7-3d. Maximum temperature and SOI

Figure 7-3d shows the relationship between maximum temperature and ENSO. Here the SOI is inverted. As before, the relationship is closer in some periods than in others. (Correlation coefficient: Tmax to SOI = -0.310)

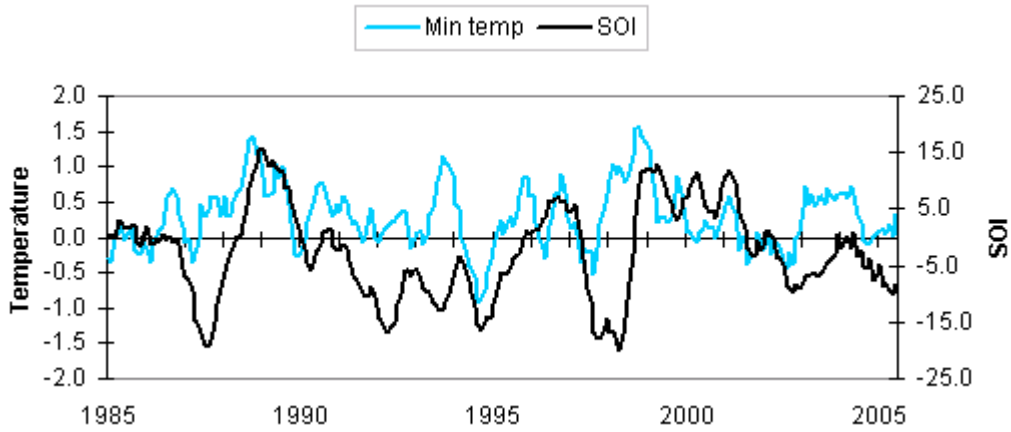

Figure 7-3e. Minimum temperature and SOI

Figure 7-3e shows the relationship between the minimum temperature and SOI. It is sometimes assumed that SOI brings warmer minimum temperatures but this does not appear to be the case. In fact the relationship between these factors is unclear. (Correlation coefficient: Tmin to SOI = 0.282)

Perhaps a change in SOI is reflected inversely in the minimum temperature around 6 months later. This relationship does not hold for the entire period but certainly does for a substantial part of it. Another option is that minimum temperatures in Australia precede corresponding ENSO conditions, which would mean that either the minimum temperatures directly influence the ENSO system or, more likely, that the same driver influences both but impacts Australia's temperatures first.

The weakened relationship between the two temperature anomalies and the SOI might be due to the amount of heat used in the latent process of evaporating recent rainfall. Normally a decrease in SOI, towards El Nino conditions, would be accompanied by a reduction in cloud and hence a drop in minimum temperatures. But the evaporation of excess ground moisture

would modulate the effects of a clearer sky. Figure 7-3f shows the rainfall using the same 6-month averaging as was used in the above figures.

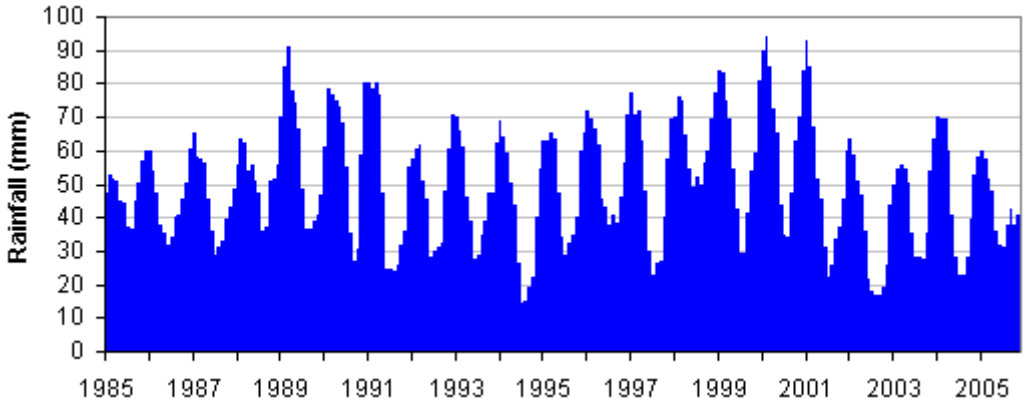

Figure 7-3f. Rainfall across the period of the above graphs

Another possible influence is wind. One example of this is in winter when the oceans off the east coast of Australia are warmer than the land and the prevailing winds are move warm air onshore

Figure 7-4[33] shows the sea surface temperatures in June 2001. The long-term average June mean temperature in Queensland is 16.68C and in New South Wales 10.34C but the water temperature off the coast at this month was considerably warmer. The Bureau of Meteorology archive of sea-level pressure maps indicates that during that month easterly winds were quite common especially near the border of the two states.

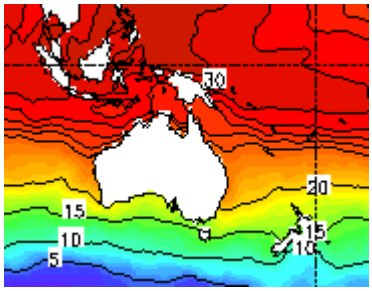

Figure 7-4 Sea surface temperatures around Australia in June 2001

The conclusion to be drawn from the above is that ENSO conditions do impact temperatures in eastern Australia.

In theory a move towards an El Nino is accompanied by a reduction in cloud and a consequent increase in diurnal temperature range because daytime temperatures are higher but nighttime temperatures are lower.

In practice it appears that plausible that excess moisture will modulate these effects and in particular cause minimum temperatures to be warmer than they would be under drier

33 Extract from sea temperature image from the Optimum Interpolation Sea Surface Temperature Analysis by the US National Oceanic and Atmospheric Administration (NOAA). See http://www.emc.ncep.noaa.gov/research/cmb/sst_analysis/

conditions. There is also a strong possibility that another potential disruption to the relationship might be due to wind speed and direction.

Although some of the relationships between various factors and the SOI vary in strength over time, there is no consistency in the variation that can reasonably be attributed to increasing greenhouse gas levels and one must therefore conclude that these emissions have no impact on Australia's temperatures.

7.4 Sea level

Claims about rising sea level around Australia usually refer to the 1.2mm/year rate given by Church et al (2006)[34]. The report "Climate Change in Australia - technical report 2007" quoted this figure but it is by no means alone.

The fundamental problem with such claims is that the rate of rising is not determined from observational data because only four tidal gauges provided sea level data prior to 1960 – Townsville (Qld), Williamstown (Vic), Fremantle (WA), and Fort Denison (NSW) – and only the latter two prior to 1940.

The claims are in fact based on synthesised data derived from estimating the sea level back to 1920 at several locations for which as little as 20 years of data is available.

Church *et al* (2006) comments on the methods used in the synthesis:

> We use this dataset to reconstruct global sea levels using the approach developed by Church et al. (2004). This approach uses the near global coverage from satellite altimetry to estimate the global covariance structure of observed sea-level variability from January 1993 to December 2001. We then use this covariance structure to interpolate the relatively sparse but longer tide-gauge records. Church and White (2006) used this technique to estimate global averaged sea level back to 1870 and to detect a 20th century increase in the rate of sea-level rise.

Church *et al* (2004)[35] does provide more information but the process is ultimately based on a statistical relationship between monitored sea level and meteorological observations being extrapolated into periods for which observations are available but not monitoring of sea level.

Such a technique embodies numerous assumptions, including that historical forces on sea level are exactly the same as recent forces on sea level. That may be a false assumption when recent ENSO events have generally been more intense and more persistent than events earlier in the twentieth century. Wind patterns and even ocean currents may have shifted. Local marine environments may have changed due to natural or human causes and this altered the distribution of water. Changes to the geological substrata, such as those caused by extracting subterranean water, may have also caused sea level change in recent or historic times.

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34 Church, J.A., J.R. Hunter, K.L. McInnes, N.J. White (2006) - Sea-level rise around the Australian coastline and the changing frequency of extreme sea-level events" Australian Meteorological Magazine, 55, 253-260

35 Church, J. A., N. J. White, R. Coleman, K. Lambeck and J. X. Mitrovica, (2004), Estimates of the Regional Distribution of Sea Level Rise over the 1950–2000 Period, *Journal of Climate*, 1 July 2004, vol 17, pp 2609-2625

It was shown earlier (chapter 6) that ENSO conditions have altered since 1976. Church et al (2006) comments on the impact of these conditions on sea level:

> The observed interannual sea-level variability is strongest at locations along the northwestern and western Australian coast. This variability is clearly related to El Niño–Southern Oscillation (ENSO) events and is transmitted through the Indonesian Archipelago from the equatorial Pacific Ocean and then anticlockwise around Australia. The signal is strongest in the north and west and gradually gets weaker further to the east. However, remnants of the ENSO signal can be seen through the Great Australian Bight and as far east as Williamstown and Burnie. The interannual variability on the east Australian coast is generally smaller in magnitude. Major features of the interannual variability, particularly the ENSO signal, are well produced in the reconstructed sea levels (correlations greater than 0.6, and as high as 0.89, for records longer than 30 years).

This comment is certainly true for Fremantle (WA) when sea level anomalies are used rather than raw sea-level figures[36] (see Figure 7-5) and obvious correlations can be seen in the corresponding record for Williamstown (Vic) (see Figure 7-6).

Church et al (2006) implies that a correlation with ENSO activity cannot be seen in east coast sea level records but sea level anomalies for Townsville indicate some correlation (see Figure 7-7) and a check of some of the monthly data suggests that wind speed and direction may corrupt the relationship.

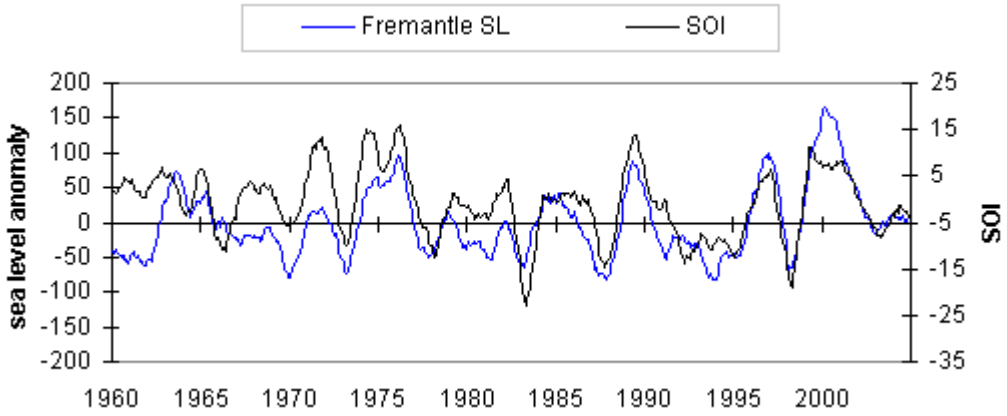

Figure 7-5. Sea level anomalies at Fremantle (WA) and SOI

36 data from the Permanent Service for Mean Sea Level, Proudman Oceanographic Laboratories, U.K.

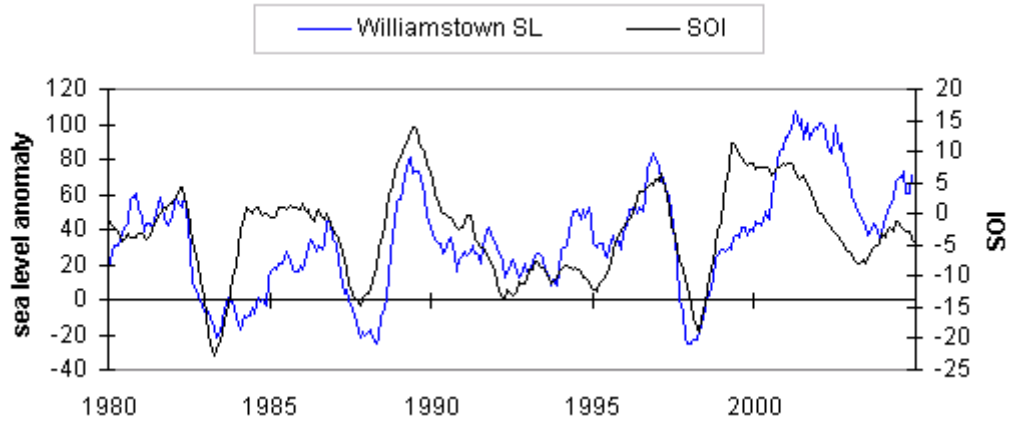

Figure 7.6. Sea level anomalies at Williamstown (Vic) and SOI

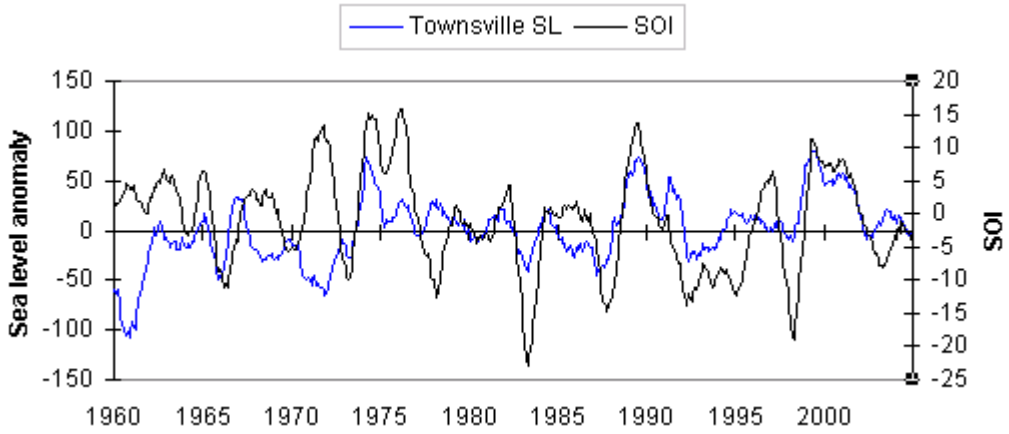

Figure 7-7. Sea level anomalies at Townsville and SOI

The annual average sea level anomalies - and their 11-year averages - present a picture of inconsistency between the three sites noted above. (see Figures 7-8, 7-9 and 7-10). The long-term averages at each site are quite different and suggest causes that are local rather than widespread or even global.

The end date of 1950 for the sea level increase in Fremantle is consistent with an increase in mean temperature about that date and a reduction in the diurnal temperature range, which is usually closely linked to an increase in cloud cover, and with a reduction in winter rainfall. A natural climate shift therefore appears the likely cause of that inflection in the 11-year average.

The extended period of little change from 1950 to 1995 was only disrupted by the strong La Nina episode that followed the El Nino of 1997-98.

In other words sea level in Fremantle appears to be driven by natural climate factors including the Southern Oscillation.

A close check of the data for Williamstown (Vic) shows that a second set of sea level data exists for the period from 1966 to 1990. This second set is consistently 88 millimetres higher than the longer-running set until January 1970 when the values start being identical. It appears that the long-running set switched to a new tidal gauge, which was at a different height above sea level, when it should have been terminated and a second set commenced.

The long-term average at Townsville starts low only because of substantial lows in 1960 and again in the early 1970s. Variations in sea level are very minor and only increase slightly during the late 1990s during the same La Nina as mentioned above.

The above variations in sea level have plausible natural or specific man-made causes but incorporating these into estimates of historic or future climate is a dubious proposition.

At the end of the day the issue for this Review is not whether Australian sea level is rising but whether any significant change in sea level can be attributed to human activity. According to the data that seems highly unlikely.

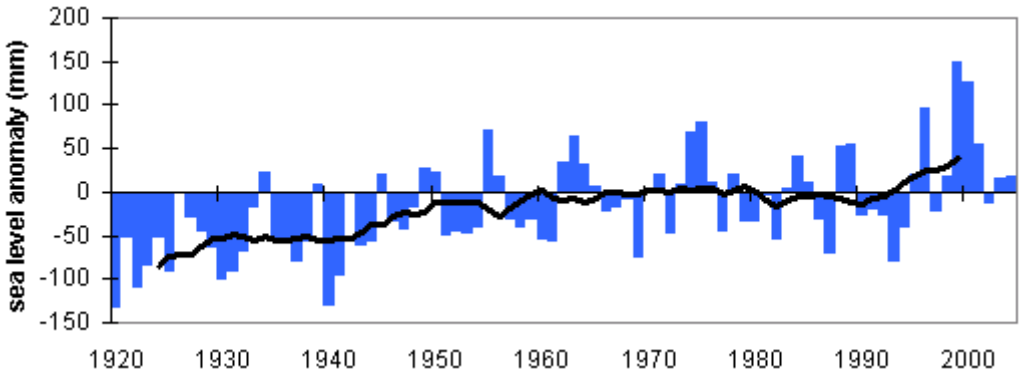

Figure 7-8 Annual average sea level anomaly and 11-year average at Fremantle

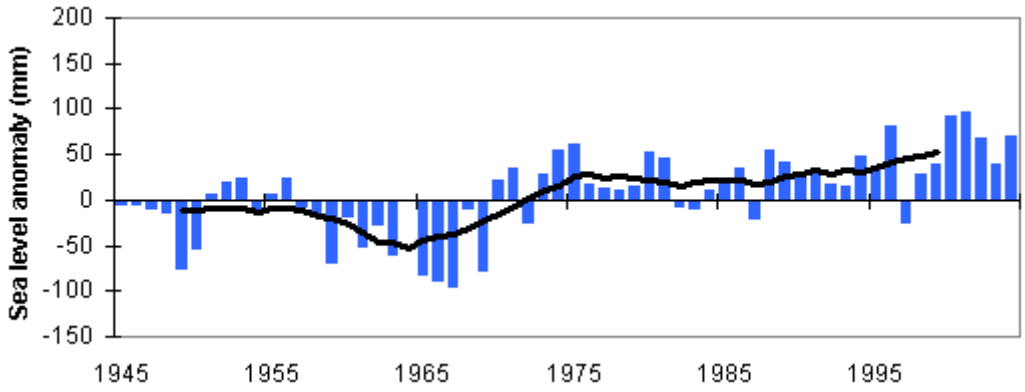

Figure 7-9 Annual average sea level anomaly and 11-year average at Williamstown. Changed to a new gauge, which was reporting sea level 88mm higher, in January 1970

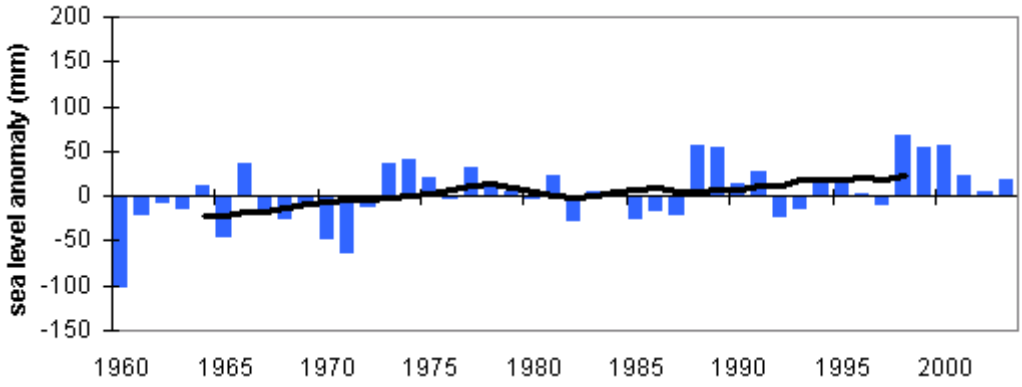

Figure 7-10 Annual average sea level anomaly and 11-year average at Townsville

7.5 Great Barrier Reef sea temperatures

It is often claimed that sea temperatures along the Great Barrier Reef are rising and that this warming is threatening the future of the reef. Figure 7-11 shows the average monthly sea surface temperature across the area of the Marine Park, according to data from NOAA's Optimum Interpolation Sea Surface Temperature Analysis.

The only evident warming occurs during El Nino events or periods approaching those conditions. No persistent long-term warming is evident and if maximum sea temperatures ever caused bleaching then falling maximum temperatures suggest that this has ended.

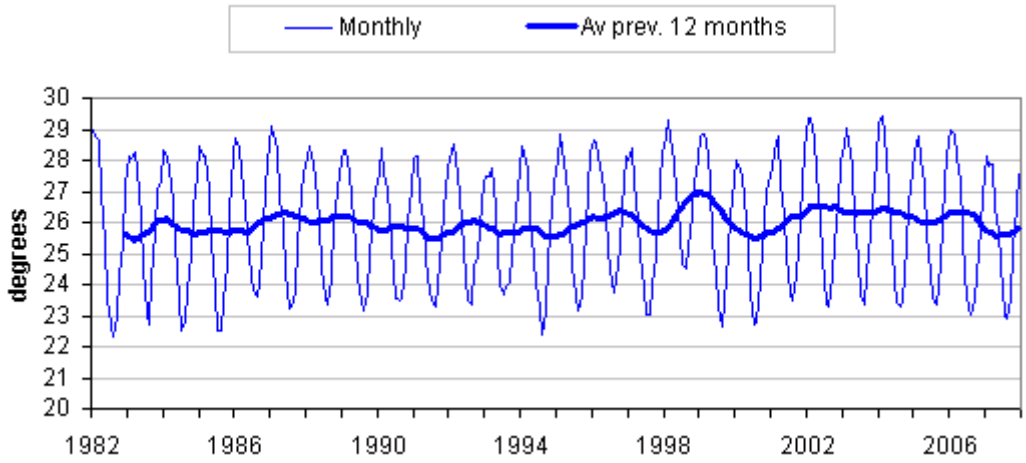

Figure 7-11. Sea surface temperatures across the Great Barrier Reef

The data can also be presented as a monthly anomaly from the average for that month across the entire period of data i.e. 1982-2007 (see Figure 7-12) and the influence of ENSO conditions dominates the period from 1998 to 2005.

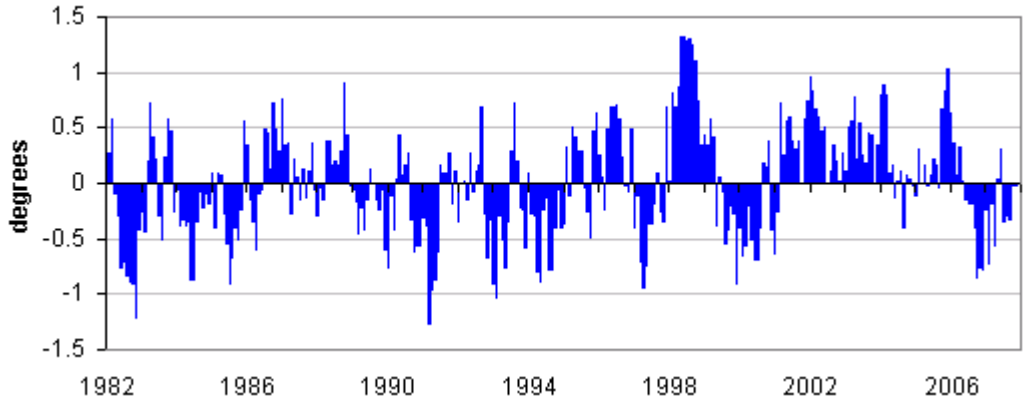

Figure 7-12. Sea surface temperature anomalies for the Great Barrier Reef

There is no evidence that the sea temperatures along the Great Barrier Reef are increasing. Temperatures appear to rise and fall with ENSO conditions, especially since 1998.

7.6 Summary

Almost all of Australia's climate factors are influenced by the ENSO conditions in the Pacific. The "Climate Change Australia" report acknowledged that several factors were impacted by those conditions and here it has been shown that both sea level and temperature are likewise affected.

ENSO conditions changed markedly with the Great Pacific Climate Shift of 1976 so it is no surprise to that climatic conditions since that time are different to what they were pre-shift. The abrupt nature of that shift across the decade 1971-1980 suggests that it was caused by a natural and somewhat cataclysmic event rather than as a consequence of human activity.

Long-term trends that include that decade of transition indicate patterns of change that are often falsely interpreted as showing a human influence. In reality that climate shift should be treated as a step and the phases before and after that shift be dealt with separately.

When this is done there is no evidence to suggest that human activity is modifying Australia's climate. It follows therefore that the various natural climate factors will continue to vary in their usual manner. The accent is on sustained levels and natural ranges of variability rather than trends that show any continuous change in conditions.

Underlying these natural variations is the influence of ENSO situations that are biased towards El Nino conditions.

This ENSO pattern is very evident over the last 15 years (see Figures 7-13 and 7-14) and until there is better understanding of the cause of that climate shift we should assume that such conditions will continue.

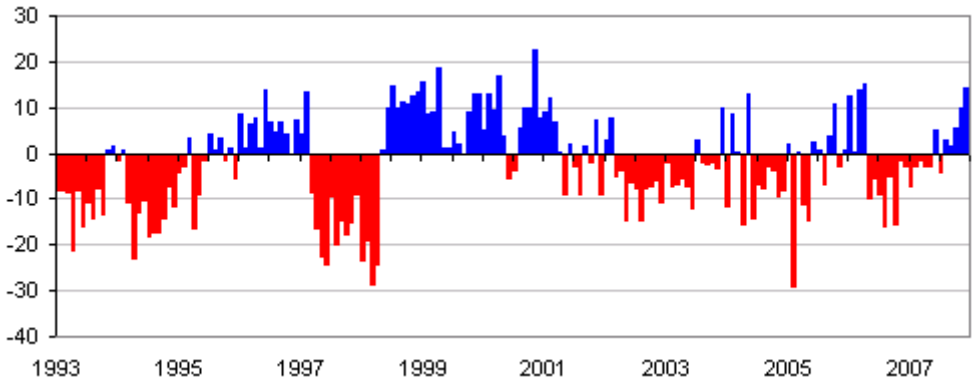

Figure 7-13 Monthly SOI values from January 1993 to December 2007

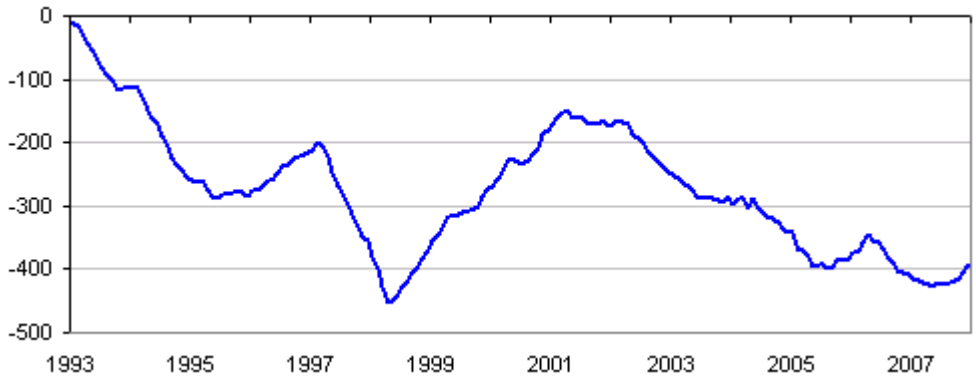

Figure 7-14. Aggregated monthly SOI over the same period as 7-13 illustrates the bias to negative SOI conditions (i.e. towards El Nino)**.**

This means that lower rainfall than prior to 1976 is to be expected in much of Australia, along with a sustained period of temperatures that are consistent with this ENSO situation.

Funding of projects that assume a human influence in Australia's climate despite the lack of clear evidence will be misdirected. Directing that funding to projects that mitigate the impact of the ENSO bias, especially to projects related to water resources, is far more likely to be beneficial.