Submission

by John McLean

to

The Victorian Coastal Council

With respect to its

Draft Victorian Coastal Strategy

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CONTENTS

Executive Summary	3
Chapter 1 - Introduction	4
Chapter 2 - Lack of Evidence for Man-made Climate Change	5
Chapter 3 - Australia's Climate	11
Chapter 4 - Victoria's Climate	17
Chapter 5 - Global sea level	20
Chapter 6 - Measurement of Victoria's sea level	23
Chapter 7 - Changes in Victoria's sea level	28
Chapter 8 - Ocean Acidity	31
Chapter 9 - Comments and Recommendations	34

Executive summary

This submission shows that despite the frequent assertions to the contrary there is no solid and irrefutable evidence of a human influence on climate. Variations in Australia's climate can be very largely attributed to the El Nino - Southern Oscillation (ENSO) system that operates in the tropical Pacific.

The link between the ENSO system and the climate in eastern Australia is noted and attention is drawn to the fact that northern Victoria comes under the influence of the ENSO system but the coastal regions in the south have a mixture of ENSO forces and those from the Southern Ocean.

Victoria's sea surface temperature is shown to be seasonally fluctuating and fluctuating over periods of years but that no long-term trend is evident from the data.

The question of predicted changes in sea level is addressed and the point made that a very highly qualified organisation predicts far less change than does the Intergovernmental Panel on Climate Change (IPCC).

The calculation of long-term sea level trends and predictions of future sea level are not made from monitoring and observation but from reconstructions based on dubious assumptions, especially the assumption that land masses are neither rising nor subsiding.

A close examination of the data from a number of tidal monitoring stations along the Victorian coast shows that those assumptions are false and that tidal stations are moving up and down relative to each other. An examination of sea level anomalies (i.e. variations from monthly averages) shows that sea level is largely governed by the ENSO system but that other forces, probably wind, play an important part.

With the ENSO system largely governing both the climate of coastal Victoria and sea level there is no good reason to consider that weather conditions will become warmer or that rainfall will continue to decline. On the other hand, the "semi-El Nino" conditions that started about 1976 look set to continue and this will bring its own set of problems.

This document concludes with 8 recommendations that are considered to be pertinent for the future well being of coastal Victoria.

1. Introduction

Under the heading "Future Challenges" the draft version of the Victorian Coastal Strategy report cites various claims and predictions about the current and future climate and sea levels both globally and for coastal Victoria.

On global matters the draft refers to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) and in reference to the Gippsland coastline, an unspecified report from the CSIRO.

The theme of the impact of climate change is repeated at several points in the draft strategy report, specifically pages 24, 28 and 40, and the assumption appears to be that rising temperatures, rising sea levels, decreasing rainfall and an increase in extreme events can be taken for granted.

Such an assumption is clearly based on the statements from the IPCC and CSIRO, and we are explicitly told, "Because of the thermal properties of water, sea levels will likely continue to rise even if we stabilise greenhouse gas emissions in the atmosphere."

There is in fact **no substantial evidence** to support the assertions of the IPCC and the CSIRO.

This document will show that there is scant evidence for a human influence on climate in a general sense and natural causes are very plausibly the reason for a recent change in Australia's climate. The observation will be made that the climate of Victoria's coastline is a mixture of forces including the atmosphere over the Southern Oscillation and that sea surface temperatures along Victoria's coast show fluctuations but no sign of a substantial trend towards warming.

The issue of global sea level change will then be discussed and it will be shown that the IPCC's estimates of future sea levels are based on estimated historical sea levels, satellite-based monitoring and computers models. Another more highly qualified group of recognised experts undertakes observations in the field to determine if sea levels have changed, and if so the likely causes of those changes and whether further changes can be expected. These experts predict very little change in sea level by year 2100, which is quite at odds with the IPCC's claims.

The integrity of sea level data obtained by tidal gauges along Victoria's coastline will be discussed and discrepancies in the data will be noted along with the very obvious problem of tidal gauges rising and falling with respect to one another.

An analysis of Victoria's sea level will be undertaken by using a representative set of data of good but probably not perfect quality. In the final analysis it will be shown that variations in sea level along Victoria's coastline can be attributed to just a small number of factors and none of them are influenced by human activity.

A number of recommendations are made, especially in relation to the natural change in Australia's climate that was mentioned above.

Most of the information in this document is based not on the opinions of others but directly on data for which the sources are given. Numerous graphs are provided so that readers are free to draw their own conclusions.

2. Lack of evidence for man-made climate change

In the draft version of the Coastal Strategy the Victorian Coastal Council noted the claims made by the IPCC and others about how rising temperatures were "very likely" the product of anthropogenic emissions of greenhouse gases.

The draft went on to cite the increases in temperature and rises in sea level as predicted by the IPCC before moving to the CSIRO's regional predictions of sea level, and both sets of predictions were ultimately based on the assertion that human activities are impacting climate.

Neither the IPCC nor the CSIRO provided any credible and compelling evidence for this assertion.

In its various climate reports, (of dubious quality without exception[1]), the CSIRO has simply made assertions based on the claims of the IPCC.

The IPCC, which is somewhat biased because its charter is specifically to assess the risks of human-induced climate change, has in its Fourth Assessment report (2007) provided a large introductory spiel about what carbon dioxide might do and followed it up with what it regards as four substantial pillars of evidence

The IPCC contends that a significant human influence on climate is proven by four pieces of evidence but each of these is very weak:

Pillar 1 - The world is warming and the temperature increase is widespread,

but...

- There is good reason to question the accuracy of that temperature data. It is based on data in grid cells of 5 degrees latitude by 5 degrees of longitude with the value in each cell is determined from meteorological observations in that region. The quality of that data is suspect because it is not difficult to find instances of temperature data from grid cells that are up to 10 degrees different to temperatures in the surrounding 8 grid cells. It is also not difficult to find instances where the relationship between the temperatures in adjacent grid cells abruptly changed.[2]

- A warming world is not conclusive proof that human activity is responsible because global temperatures have risen and fallen on previous occasions. During the Ice Ages cooling was certainly widespread so what is unusual about warming being widespread?

[1] 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 at http://mclean.ch/climate/EE%2017-1_03%20McLean%20ok.pdf)

[2] see section 3 of my submission to the Garnaut Climate Change Review (online at http://mclean.ch/climate/Garnaut_submission.pdf)

Pillar 2 - 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?

Pillar 3 - The distribution of warming is not consistent with models,

but...
- There is no evidence whatsoever that the models are accurate and complete, which 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 perhaps 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.

- 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 from the tropics and the northern 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.

Pillar 4 - Climate models need to include an anthropogenic (i.e. "human") component in order for the output to match the observed surface temperatures,

but...
- As noted above in discussion of pillar 3, there are good reasons to believe that the models are inaccurate and incomplete. 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.

- 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 mixed with the output of the incorrect models. Many of the CSIRO climate reports show the range of variation in output when the models process the same set of data, and it is a point that I made in my review[3].

- An incomplete and immature science like climatology is not settled by any kind of vote, which is what a consensus really is, not matter whether that is a vote by a show of hands or an averaging of the output of models.

- The symptoms for which an anthropogenic input is claimed to be required are likely to be 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 correcting deficiencies in the processing algorithms of climate factors that are poorly understood.

- Any assumption that the models truly are complete and accurate is challenged by the frequent reports in the scientific press of improved understanding of known climate factors or announcements of new discoveries that may have an impact on climate.

How accurate are the IPCC's climate models?

In a posting on 4 June 2007 to a weblog operated by "Nature" Kevin Trenberth[4], a coordinating lead author of a chapter of the IPCC's assessment reports, 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 cannot work for many aspects of climate, especially those related to the water cycle. For instance, if the 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

[3] 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 at http://mclean.ch/climate/EE%2017-1_03%20McLean%20ok.pdf)
[4] See http://blogs.nature.com/climatefeedback/2007/06/predictions_of_climate.html

> only obtaining sufficient reliable observations of all aspects of the climate system, but also overcoming model biases. So this is a major challenge."

The Summary for Policymakers to the IPCC 4AR Working Group I (WGI) report showed how poorly the models replicate historical climate. Figure SPM-5, a repeat of figure 10.4 of the WGI report, showed the predicted temperatures under different scenarios of greenhouse gas emissions forward from year 2000 and in order to provide context it included 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, but in various publications that range has disappeared and been replaced by a single line.

Figure 2-1 shows the portion of graph SPM-5 that contains the simulation of the twentieth century and Figure 2-2 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.

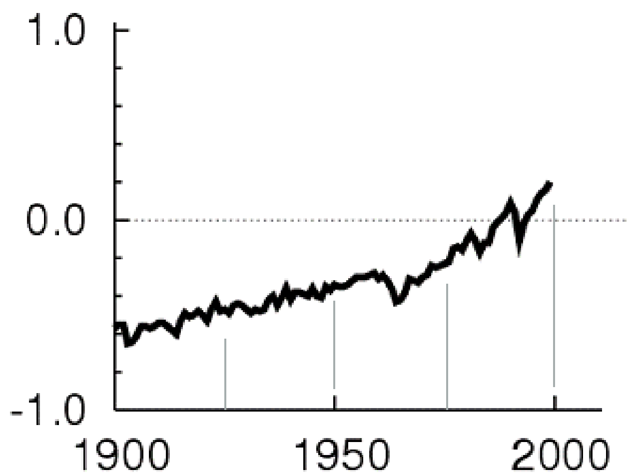

Figure 2-1. Estimated historical annual average temperature anomalies according to 23 climate models (part figure SPM-5 of IPCC WG I report)

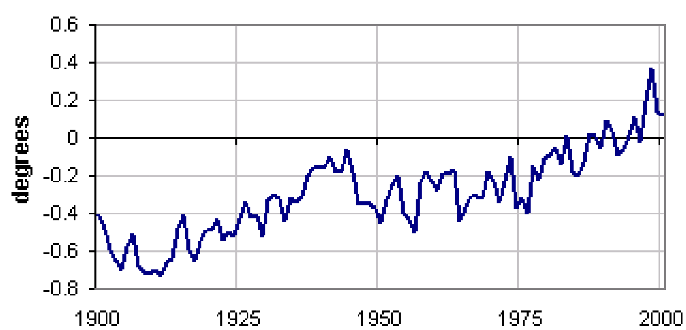

Figure 2-2. Annual average temperatures according to CRU data (0 line = average 1980-99)

If the models were accurate then these graphs should be almost identical for at least a substantial part of the period. The output from the models clearly fails to match the observational data according to the CRU. The low point around 1910 is missing from Figure 2-1 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 2-1 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. And with this demonstration of the inaccuracy of the models the IPCC's third and fourth pillars of purported evidence for a human influence on climate crumble to dust.

The IPCC also fails to explain the logarithmic nature of the relationship between atmospheric carbon dioxide and down-welling radiation, the latter being the "greenhouse process".

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 2-3. The Y-axis indicates the downward radiation in Watts/m^2.

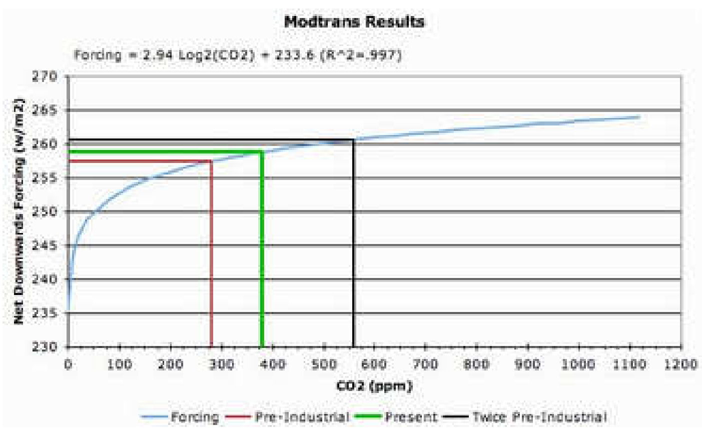

Figure 2-3. Downward radiation caused by carbon dioxide, according to MODTRAN software

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[5]) to more than 1.1 according to climate models, and that range includes an estimate by NASA's James Hansen (2003)[6] of between 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 [7].

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℃ and 4.5℃. 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.

Temperatures cannot be predicted until the crucial factor is know to good accuracy and a similar level of understanding is reached for the various positive and negative feedbacks.

If temperatures cannot be accurately predicted then it follows that changes in sea level caused by either thermal expansion or by the melting of ice and snow also cannot be accurately predicted.

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

[6] Hansen, J (2003), Can we defuse the Global Warming Time Bomb?, N*atural Science*, August 2003

[7] For more discussion see http://junkscience.com/Greenhouse/What_watt.html (accessed Jan 2008)

3. Australia's climate

In the mid 1970s Australia's climate underwent a significant shift and most, if not all, climate factors were impacted.

This can be shown by aggregating the anomalies (i.e. difference from a base value that is usually either zero mid-point or some long-term average) in order to observe key points of change, which indicate some extended period of divergence from earlier values.

Figure 3-1 shows such a graph for data from eastern Australia with the values of the metrics all scaled to fit within a similar interval.

In this graph
- "Mean temp" is the anomaly of the annual average mean temperature, (i.e. increase over the average 1961-90 temperatures)
- "DTR" is the anomaly of the diurnal temperature range (i.e. maximum temperature minus minimum temperature),
- "SST" is the anomaly of the sea surface temperature around Australia,
- "SOI" is the Southern Oscillation Index (which is a key indicator of ENSO conditions and is already a form of anomaly), and
- "Rainfall" is the anomaly in average rainfall from the average rainfall across 1961-90.

The DTR and SOI values are inverted in order to make the relationships clearer.

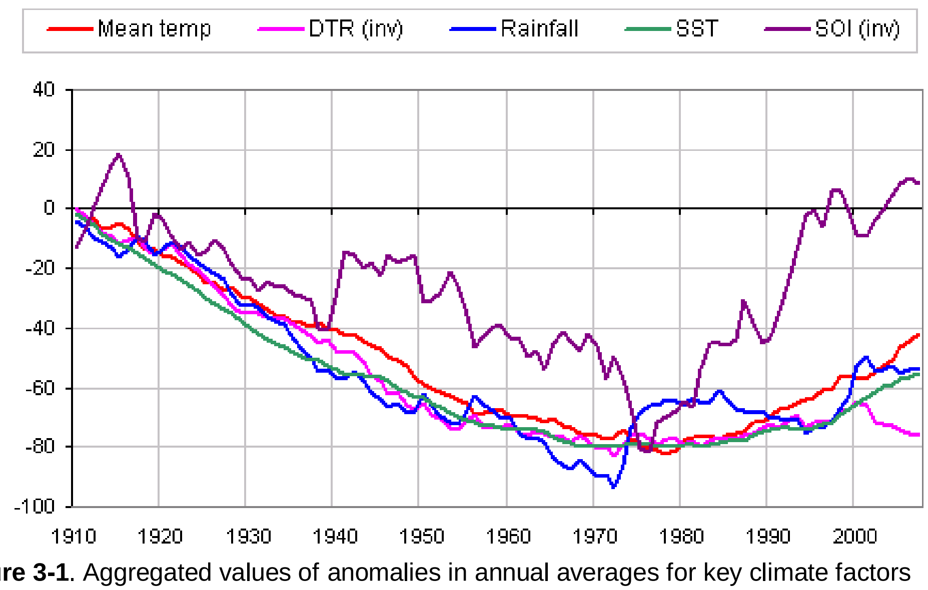

Figure 3-1. Aggregated values of anomalies in annual averages for key climate factors

It is clear that a shift in Australia's climate occurred sometime in the 1970s, but what could have caused it?

One plausible answer is that it was part of the Great Pacific Climate Shift, which is an event widely recognised by meteorologists and climatologists.

Guilderson and Schrag (1998)[8] 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)[9] took this further and estimated that the upwelling in the tropical Pacific decreased by about 25%, from 47 sverdrups[10] in the1970s to 35 sverdrups in the 1990s.

That reduction in cold water upwelling is highly significant because this water cools the Pacific 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 3-2 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.

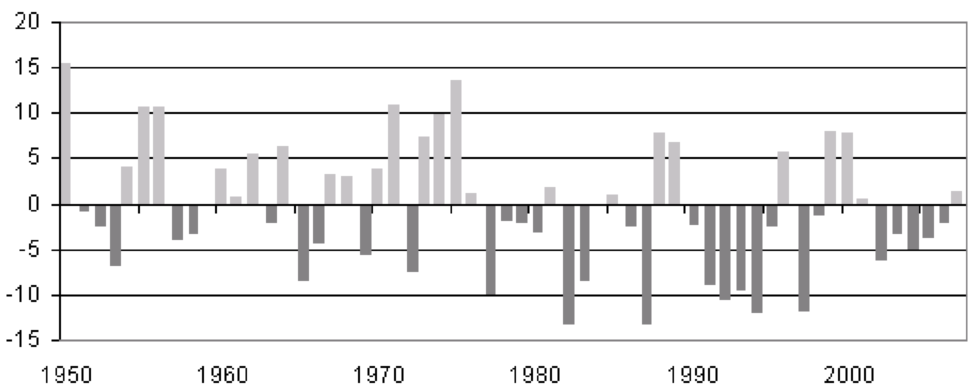

Figure 3-2. Annual average Southern Oscillation Index (1950 - 2006)

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

Figure 3-3 is a graph of the aggregated SOI since 1950 and the turning point corresponding to the Great Pacific Climate Shift is obvious.

8 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

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

10 1 sverdrup = 1 million cubic metres/second

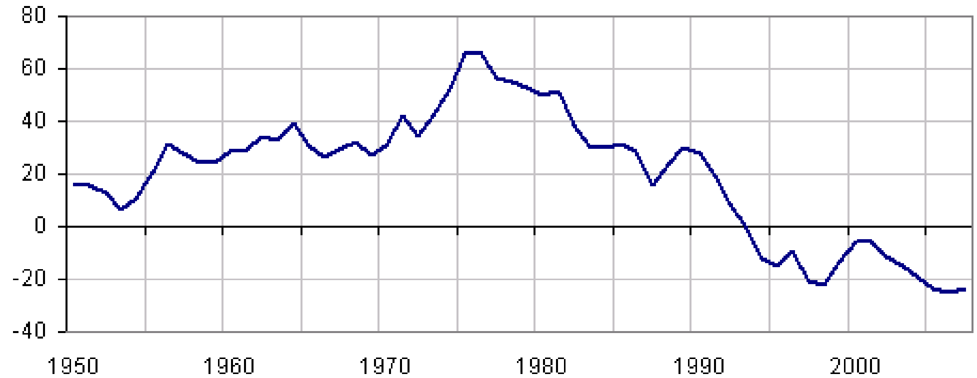

Figure 3-3. Aggregated average annual SOI values

This shift in the SOI is consistent with the findings of Vecchi and Soden (2007)[11] 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.

This shift in SOI values is that the mean SOI now greatly favours the direction of El Nino conditions. Figure 3-4 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.

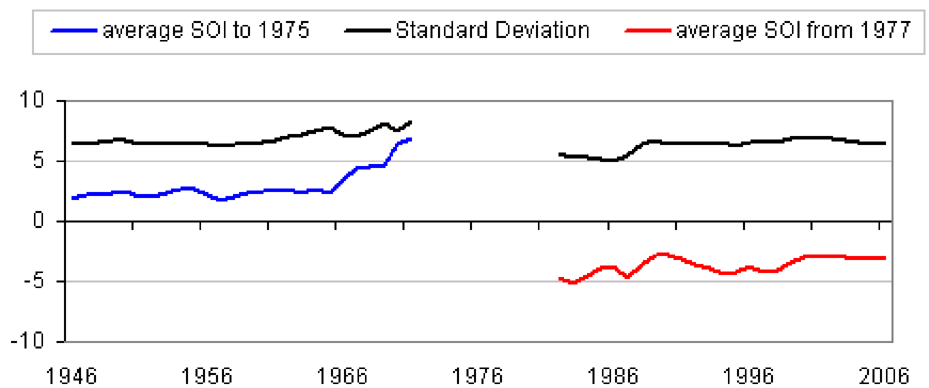

Figure 3-4. Average SOI to 1975 and from 1977, and standard deviation

The standard deviations, calculated in parallel with the averages in each period, about the pre- and post-shift means are very similar. That indicates that the pattern of variation in the SOI is not abnormal.

Perhaps alarmingly, the shift was not in the transient forces that determine if a La Nina or El Nino event will occur but in some underlying and relatively consistent force. Whatever that force is, it has been influential in moving the average SOI. Across the 30 years prior to the shift (i.e. 1946-1975) the average was +1.93 and

[11] 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

across the 30 years after the shift (i.e. 1977-2006) it was -3.05, making a total shift of almost 5 points. In comparison, 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 recent average SOI represents a move of about 50% towards El Nino.

The implications of this shift in the ENSO are significant for Australia's climate.

The report "Climate Change in Australia: Technical Report 2007" (hereafter "CCA report"), a joint effort from the CSIRO and the Australian Bureau of Meteorology, makes several observations about how Australia's climate is influenced by the ENSO system.

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*)

The CCA report makes no direct mention of a relationship between the ENSO and sea level but the paper that it cites (Church *et al*, 2006[12]) 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. ...*

[12] 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

ENSO events significantly affect sea level along the west Australian coast."

Church *et al* (2006) mentions the influence of the ENSO on sea level again later in that paper and we'll return to it in the discussion of sea level in the next chapter

The CSIRO and Bureau of Meteorology seem uncertain about how the ENSO system impacts Australia's temperatures. In my submission to the Garnaut Climate Change Review[13] I show the relationship with temperature via the diurnal temperature range and cloud cover, both of which appeared in the first figure in this chapter and both of which shifted in the mid 1970's.

Australia's long-term mean temperature pattern is often illustrated by a graph with a single trend line across the entire period. If we take the year of The Great Pacific Climate Shift, 1976, and examine the mean temperatures to either side of it (see Figure 3-5) we find that another valid, and probably more plausible, account of the situation is that a step occurred in the pattern of Australia's mean temperature and a period of readjustment links the two phases.[14].

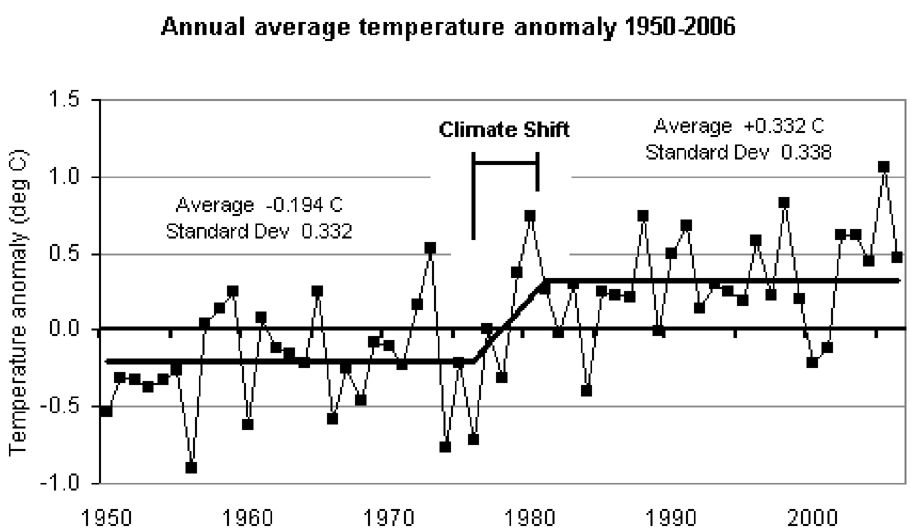

Figure 3-5. An alternative interpretation of the pattern of Australia's mean temperature

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.

[13] see sections 7.2 and 7.3 of my submission to the Garnaut Climate Change Review (online at http://mclean.ch/climate/Garnaut_submission.pdf

[14] For more details see http://mclean.ch/climate/Aust_temps_alt_view.pdf

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

It is very highly unlikely that this pattern of mean temperatures in Australia over the last 55 years 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. The key force on Australia's climate is very clearly the ENSO system and the shift in 1976 largely (or completely?) accounts for the change in Australia's climate since that time; there is simply no need to invoke notions of a human influence.

The consequences of this statement are profound. With the ENSO system now centred on a relatively permanent state of "semi El Nino" Australia's temperatures can generally be expected to be warmer than they were prior to 1976 and eastern Australia's rainfall in particular will be generally lower. It is an error to extrapolate long-term trends in temperature and rainfall into the future because the climate has simply shifted to a new "normal". The evidence suggests that the historical ranges of fluctuations about a mid point will continue rather than any increasing deterioration.

4. Victoria's Climate

Unlike the other eastern states, forces other than the ENSO contribute to Victoria's climate. The ENSO plays a major role in the north of the state but in the south the Southern Ocean plays a significant role.

This is shown in Figure 4-1, which is different to the graph of the same aggregated data for eastern Australia as a whole, shown earlier in Figure 3-1. The land and sea surface temperatures show turning points roughly in the decade 1970-80 but the diurnal temperature range (DTR) and rainfall patterns fail to correspond, and one possibility is that southerly and south westerly air flows might be responsible.

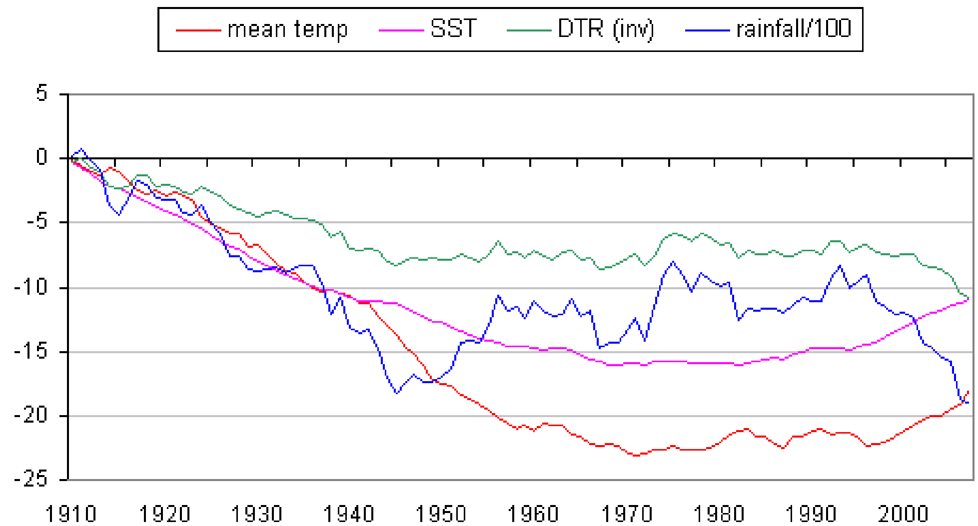

Figure 4-1. Aggregated anomalies of climate factors

The diurnal temperature range (DTR) is inversely related to cloud cover. Less cloud means more heat from sunshine during the day and a greater heat loss at night, which together mean a greater range of daily temperatures. Figure 4-1 shows the signs of cloud cover reducing since the mid 1990's, namely rainfall has reduced, sea surface temperatures have risen, daily mean temperatures have risen and DTR has increased. (NB. DTR is inverted in Figure 4-1).

The DTR appears to be linked to the Southern Oscillation Index (SOI), as shown in Figure 4-2 where the SOI is inverted. Two explanations might account for the poor match through the early 1990's - the volcanic eruption at Mt Pinatubo might have distorted the data from which the SOI is calculated or might have suppressed the normal consequences of an El Nino.

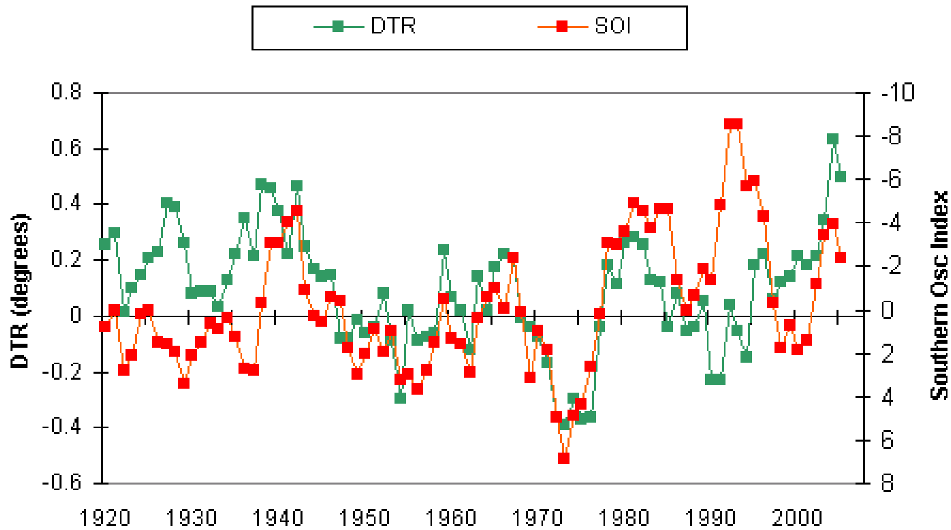

Figure 4-2. Victoria's Diurnal Temperature Range (DTR) and the Southern Oscillation Index. Annual values averages from -2 months to +2 months.

Detailed data for coastal Victoria is not freely available so it is difficult to investigate both the local climate patterns and the occurrence of "extreme events". One factor that can be explored is sea surface temperature data and Figure 4-3 shows the monthly data and 12-month running averages (previous 11 + current month) for the region defined by latitude 39S to 40S and longitude 141E to 150E[15].

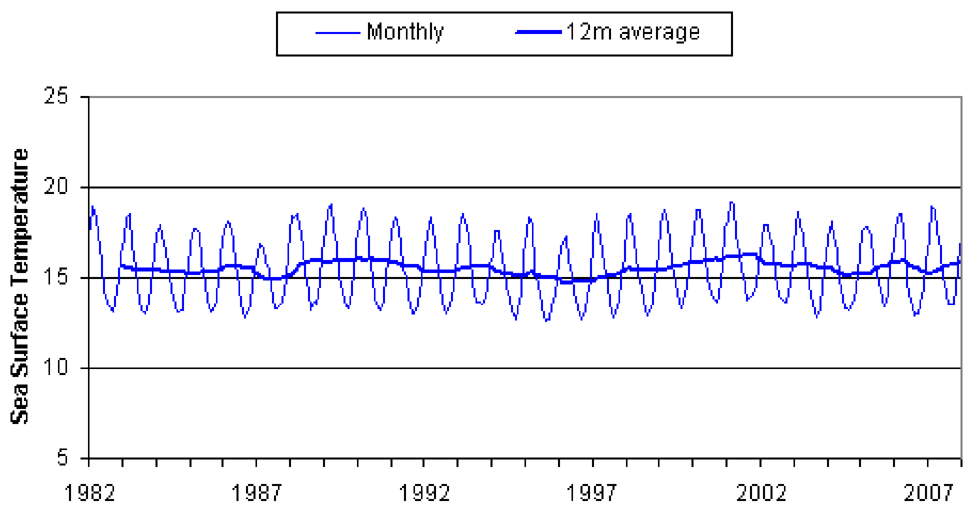

Figure 4-3. Sea Surface temperatures in northern Bass Strait. (Data from NOAA's Optimum Interpolation Sea Surface Temperature Analysis[16])

This graph shows negligible change in sea surface temperatures over the 25 years.

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[15] or more simply, a region that touches Cape Otway and Wilsons Promontory in the north, takes most of King Island to the south and stretches across Victoria. in other words, "northern Bass Strait").

[16] available at http://www.emc.ncep.noaa.gov/research/cmb/sst_analysis/

Figure 4-4 shows the anomalies from the averages for each calendar month across the entire period 1982 - 2007. Again no dramatic long-term change is obvious but there is a hint of warming from El Nino events appearing after the atmospheric events in the central Pacific (e.g. post-1987 warming, post-1998 warming).

One point that does stand out is the abrupt fall in the temperature anomaly in early 2006. The anomaly in March 2006 was 0.427 but it fell the next month to -0.324 and again to -0.976 the next month. The likely cause would seem to be a change in wind patterns.

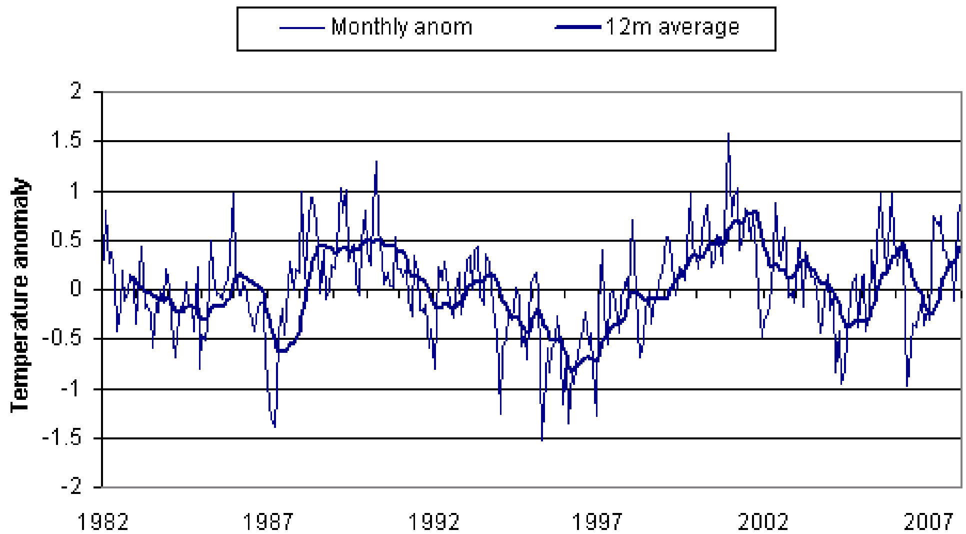

Figure 4-4. Sea Surface Temperature anomalies for northern Bass Strait

In total, Victoria's climate appears to be the product of ENSO events, the influence of which is strong in parts of the state and weaker in others, combined with the forces of the Southern Ocean and the atmosphere above it. Victoria's coastline is in that fringe area of ENSO influence and at times those influences will be strongest.

Given that climate patterns in New South Wales and Queensland are greatly influenced by the ENSO system and no hint of a human influence can be seen, it is rather implausible that a human influence could be responsible for climatic variations along Victoria's coast.

5. Global Sea Level

The draft Coastal Strategy Report referred to the IPCC's predictions about global average sea level. The IPCC's claims are based on the notion of man-made global warming and that the increase in temperature will cause thermal expansion of the oceans. It was shown earlier in chapter 2 that the IPCC provided no clear evidence of man-made warming so we should be highly suspicious of its claims about rising sea level.

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 and in the opinion of many, its experts are more highly skilled than those used by the IPCC.

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 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[17] 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.

The IPCC predicts an increase in sea level of between 26cm and 59cm by year 2100 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.

The IPCC's estimated increases in sea level based on 6 IPCC emissions scenarios are shown with the estimate from INQUA in Figure 5-1. Scenario A1F1 is the IPCC's continuation of current use of fossil fuel and unchecked emissions of carbon dioxide. The INQUA estimate shown in this graph assumes the A1FI scenario.

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[17] 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

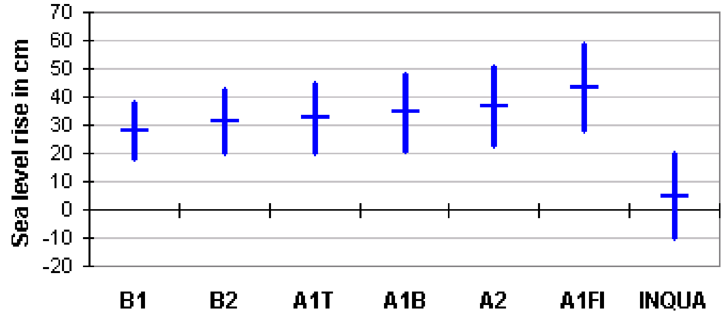

Figure 5-1. Range and mid-points of estimated change in sea level by 2099. The first 6 are from the IPCC and the last from INQUA, which predicts a change by year 2100 of somewhere in the range -10cm to +20cm

It was noted above that the IPCC relies on synthesised, or reconstructed, historical sea levels and that these levels then form the basis of its predictions out to year 2100.

These reconstructed levels are the product of John Church, an Australian who was also coordinating lead author of the chapter dealing with sea level in the IPCC's Third Assessment Report, released in 2001.

That third report was uncertain about an acceleration in sea level rise in the twentieth century but the Fourth Assessment Report, released in 2007 was quite adamant that sea level had risen sharply from 1993. The contradiction relied at least in part on the work of Church and others (Church et al, 2004[18]) to reconstruct historical sea levels.

The process described in Church *et al* (2004) is ultimately based on a statistical relationship between determined between monitored sea level and meteorological observations, and that relationship being used to determine historical sea level on the basis of meteorological observations.

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 subsidence caused by extracting subterranean water, may have also caused sea level change in recent or historic times.

Very little indication was given in Church et al (2004) as to the accuracy of such methods and whether the methods are prone to falsely attributing a change in sea level to certain atmospheric factors, so it seems necessary to take a lot of the technique on trust.

[18] 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

This same technique is used in Church *et al* (2006)[19] to estimate the historical sea level at various points around Australia and from that determine an average change in sea level. Church estimates that Australia's sea level rose an average of 1.2mm/year throughout the twentieth century but it is worth reiterating that *these estimates are based on reconstructions rather than actual measurement.*

Church et al (2006) also makes several comments about the influence of ENSO events on sea level, including two on page 256.

> *"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)."*

And ...

> "*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.*"

The relevance of these comments will be illustrated in chapter 7 of this document.

Finally, attention should be drawn to an error in figure 5 of the draft strategy, a figure in which it is claimed that sea level is rising at the upper limit of the predicted range. This legend to this figure transposes "trend - satellite data" and "trend - tide gauge data" and this is obvious because satellite-based monitoring did not commence until 1993.

The use of the term "trend" is also dubious because there is no indication of the period over which that trend was calculated and the lines are not straight. The label "trend - tidal data" might not even be correct if the calculation of that trend has incorporated reconstructed (i.e. synthesised) historical sea levels, a practice that was shown above to be dubious.

[19] Church, J.A. , J. R. Hunter, K. L. McInnes and N.J. White (2006), Sea-level rise around the Australian coastline and the changing frequency of extreme sea-level events, *Aust. Met. Mag*. 55 (2006) pp 253-260

6. Measurement of Victoria's Sea Level

Data about sea level in Victoria appears to not be publicly available free of charge from any of the agencies that gather it but fortunately it is available from the Permanent Service for Mean Sea Level[20] (or PMSML) operated by the Proudman Oceanographic Research Laboratory in Liverpool, U.K.

Good quality long-term data is available from few locations. Gippsland is very poorly monitored and only one location in all of Victoria provides data prior to 1960.

The station entry numbers in the PMSML, locations, names and periods of (at least almost) continuous data are as follows:

680/178	38 22 S 145 13 E	Stony Point	1993-2004
680/181	37 52 S 144 55 E	Williamstown	1916-30 and 1944-2004
680/182	37 52 S 144 55 E	Williamstown II	1966-1990
680/186	38 10 S 144 26 E	Geelong	1990-2004
680/189	38 18 S 144 37 E	Point Lonsdale	1963-2004
680/226	38 30 S 143 59 E	Lorne	1993-2004
680/231	38 20 S 141 36 E	Portland	1983-2004

Table 6-1. Available data for Victorian locations

The two sets of data from Williamstown cause a very specific problem for the determination of sea level at that location. As shown above, the data for "Williamstown II" is a much shorter period than from "Williamstown". A graph of both datasets across 1967 to 1970 shows a curious situation (see Figure 6-1).

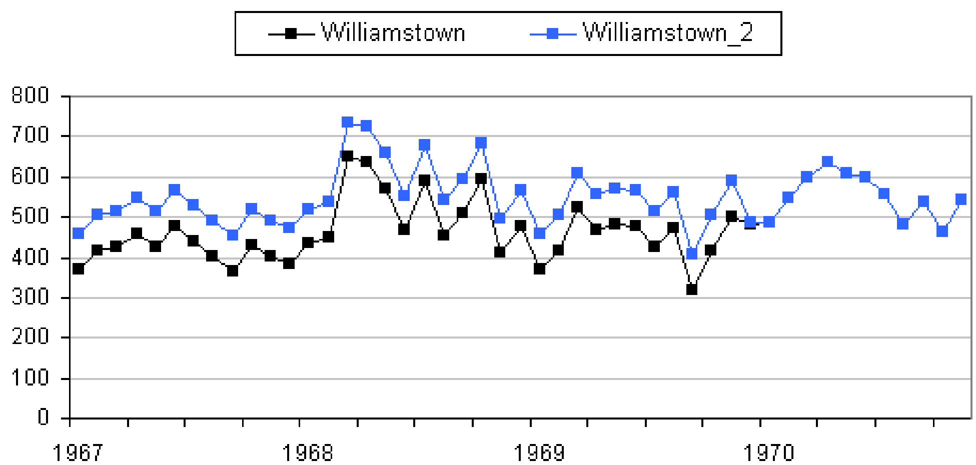

Figure 6-1. Sea level according to the two datasets for Williamstown. Values match starting in January 1970 and one graph line obscures the other.

From the starting date of the Williamstown II dataset the difference between the corresponding values was a consistent 88 millimetres but from January 1970 that difference disappeared.

[20] PMSML homepage is http://www.pol.ac.uk/psmsl/

The change is critical because the trend across 1967 to 1990 for the Williamstown II dataset is a fall of 0.10mm/year but for the Williamstown dataset it's an increase of 2.32mm/year.

Figure 6-2 puts the situation into a wider context by using 11-month averages (5 previous, current and next 5) over a longer period for this Williamstown data. The impressions that one gains from the two datasets are quite different.

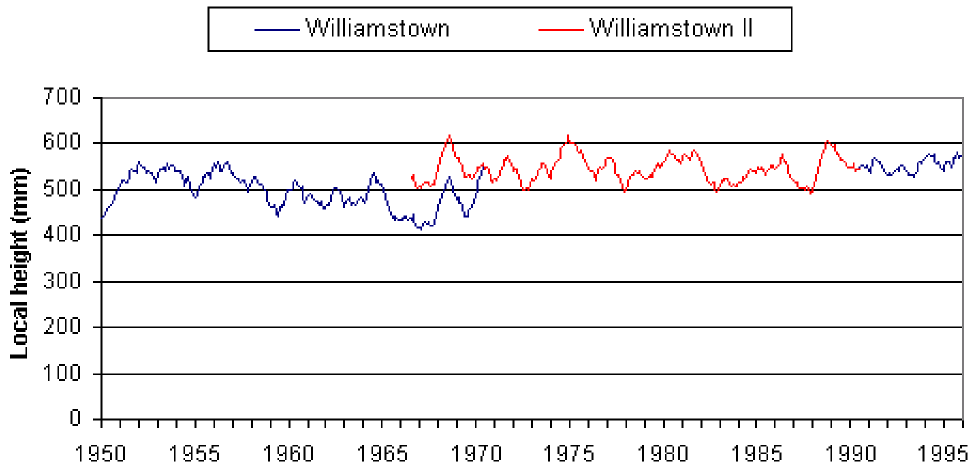

Figure 6-2. 11-month running averages of data from the two tidal gauges in Williamstown. (The "Williamstown II" graph obscures the "Williamstown" graph from January 1970 until the end of the former's data record.)

It appears that the Williamstown tidal gauge was replaced by a second gauge that was located 88mm lower (which corresponds to a water level 88mm higher). The sensible protocol would have been to terminate the "Williamstown" dataset and continue with only the "Williamstown II" dataset but this was not done. As things currently stand, the long-term Williamstown dataset is unreliable because a certain part of it is known to require adjustment and one can reasonably wonder if a similar situation existed earlier in the long-term record.

Church's method of reconstruction could not be reliably applied to the Williamstown data because of the inconsistency, but applying it to data from the other Victorian tidal stations is also exceptionally difficult.

Figure 6-3 shows the difference in relative sea level according to the Portland and Point Lonsdale tidal gauges. The difference in height for the first pair of recorded data values is adjusted to 0 and that adjustment applied consistently to the remaining data.

A rise in recorded sea level, especially one that is sustained over more than 1 year, can easily be due to the tidal gauge falling due to either the gauge mount subsiding or general local subsidence. For this reason, in Figure 6-3 the fall in the relative recorded sea level in the late 1980s, is very likely due to the Portland tidal gauge rising relative to the gauge at Point Lonsdale and the rise in relative sea level about 1995 due to a fall in Portland's tidal gauge relative to Point Lonsdale's.

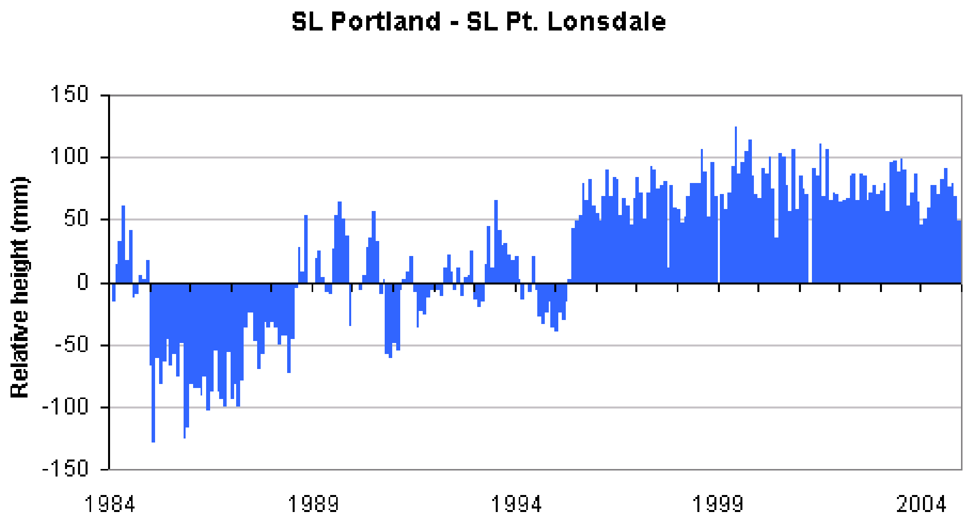

Figure 6-3. Relative difference in recorded sea levels recorded at Portland and Point Lonsdale. (Blank columns indicate missing data at one or other site.)

Several more graphs of the relationships between tidal gauges can be found at the end of this chapter (Figures 6-4 to 6-7). Attention is drawn to Figure 6-5 that shows the relative sea heights at Geelong and Point Lonsdale. The dramatic and continuous shift in relative heights for two sites just 35km apart in a direct line suggests that very local forces are at work.

These graphs also suggest that in June 1995 the tidal gauge at Point Lonsdale may have risen abruptly by about 50mm (e.g. the sharp and sustained increase near the centre of Figure 6-3). Comments were made earlier about a change of tidal gauge at Williamstown and it appears that a similar change may have occurred at Point Lonsdale but a cross-check is not possible because no second data set exists for that location exists. Alternative explanations for an abrupt shift are a natural seismic event (e.g. earth tremor or earthquake) or human activities that caused subsidence (e.g. blasting or nearby construction or engineering work).

Together Figures 6-3 to 6-7 suggest that subsidence or uplift - either local to the area or specifically to the monitoring gauge - have distorted the sea-level data for all Victorian locations at which it is monitored and therefore it should be used with extreme care.

This subsidence or uplift also makes it impossible to reconstruct historical data by correlating the limited records that exists against the meteorological observations at the time. Instead of being recognised as subsidence, an increase in recorded sea level might be falsely correlated to a weather phenomenon and the false correlation then applied to historical weather observations to estimate historical sea levels.

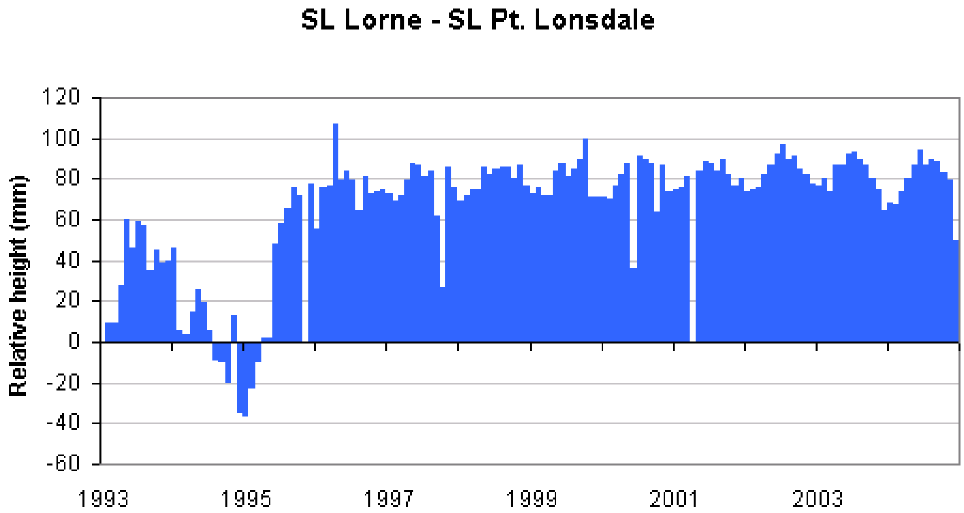

Figure 6-4. Relative difference in recorded sea levels recorded at Lorne and at Point Lonsdale. (See text accompanying Figure 6-3)

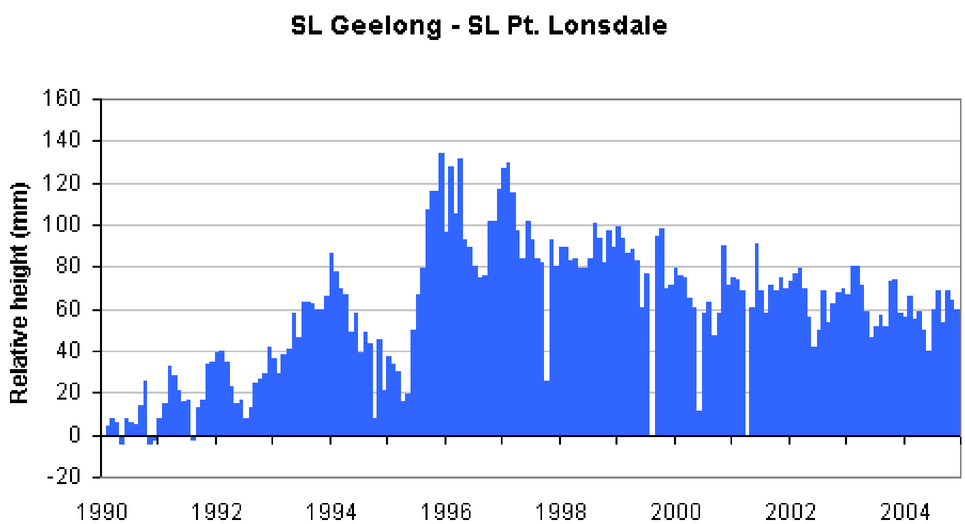

Figure 6-5. Relative difference in recorded sea levels recorded at Geelong and at Point Lonsdale. (See text accompanying Figure 6-3)

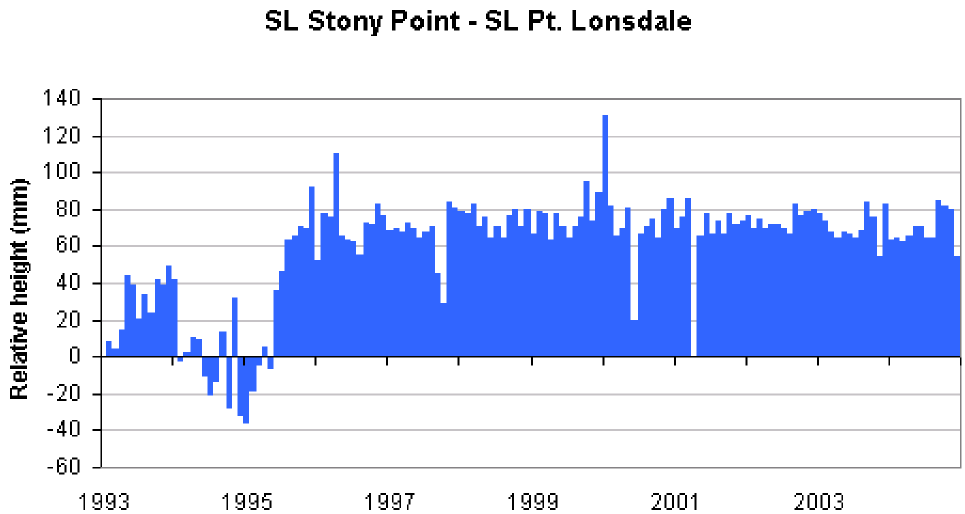

Figure 6-6. Relative difference in recorded sea levels recorded at Stony Point and at Point Lonsdale. (See text accompanying Figure 6-3)

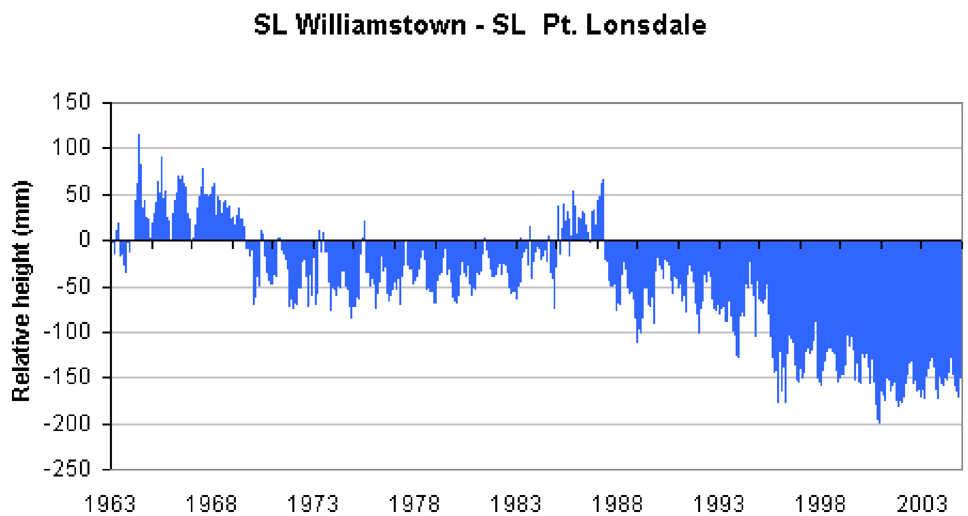

Figure 6-7. Relative difference in recorded sea levels recorded at Williamstown and Point Lonsdale. The abrupt change in Williamstown's recorded sea level at the start of 1970 (see Figures 6-1 and 6-2) is quite obvious. (See also text accompanying Figure 6-3)

7. Changes in Victoria's Sea Level

From the figures above it appears that sites Portland, Lorne, Stony Point and perhaps Williamstown were relatively stable after 1992. As mentioned above, the Point Lonsdale data looks suspicious from 1995 so it cannot be included with these locations.

A comparison of these 4 sites reveals that the differences between the monthly sea levels across 1993 to 2004 show flat trends (i.e. no obvious relative subsidence) and that the standard deviations of the difference in local sea level between a representative selection of these sites are within reasonable bounds (See Table 7-1):

Diff btwn Lorne & Stony Point	12.2
Diff btwn Stony Point & Portland	20.9
Diff btwn Lorne & Portland	12.8
Diff btwn Williamstown & Portland	29.6
Diff btwn Stony Point & Williamstown	19.5

Table 7-1. Standard deviations of the average monthly difference in sea level between the two named stations

After suitable adjustment (addition or subtraction of constant values) a graph of the sea levels at all 4 locations shows quite a good correlation (see figure 7-1), which means that these values can be used to create a single 4-station average. A graph of this average sea level has not been shown because it is virtually identical to Figure 7-1.

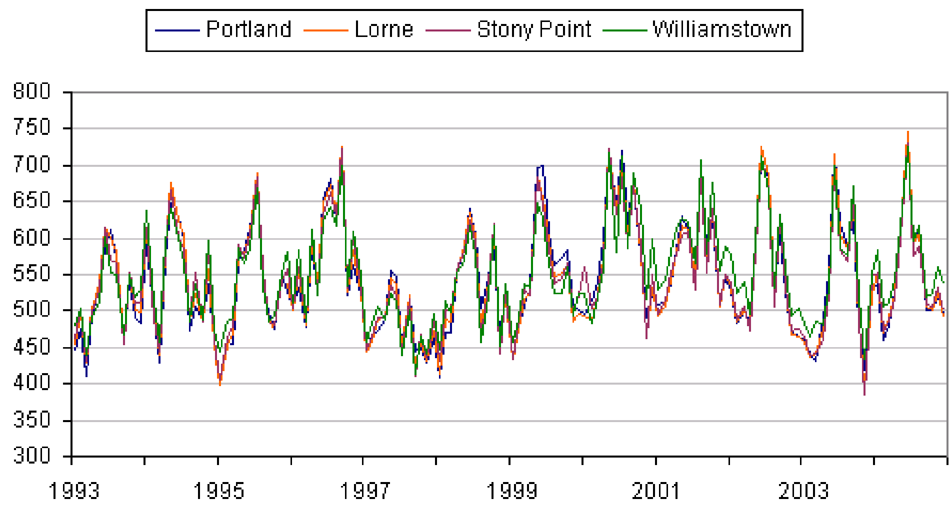

Figure 7-1. Four stations that show good correspondence from 1993 to 2004

In order to determine if consistent underlying changes in sea level are occurring, such as seas rising due to higher temperatures, it is necessary to convert the data into monthly anomalies in order to remove any seasonal effects.

The first step in this process is to determine the "normal" sea level for each calendar month by calculating the average for the month across the entire period of data, i.e.

1993 to 2004. These normal monthly values are shown in Figure 7-2. The numeric values on the Y-axis mean nothing in themselves but the difference between any points on the axis is significant. Figure 7-2 tells us that on average, sea level in June is almost 150mm higher than the average sea levels in January, February and March.

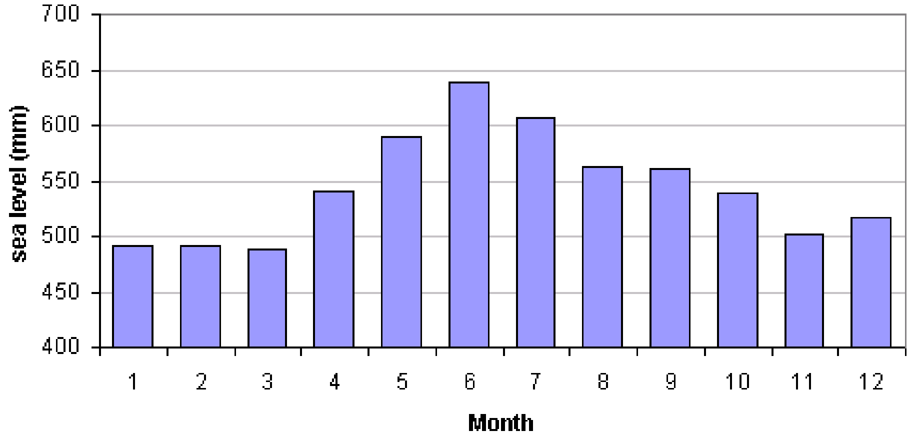

Figure 7-2. Monthly average sea level determined from the 4-station averages

The anomalies in any month can be determined by subtracting the applicable "normal" monthly sea level from the sea level for the current month. The graph of these monthly anomalies is shown in Figure 7-3.

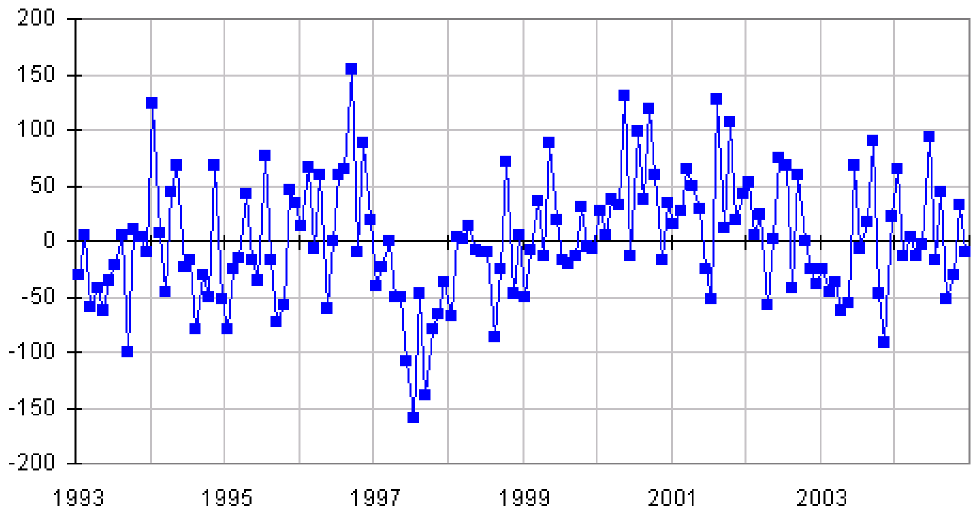

Figure 7-3. Monthly sea level anomalies based on the 4-station average sea level

The Bureau of Meteorology's webpage of archived analysis charts of mean sea-level pressure (MSLP)[21] can be used to determine that the wind was very rarely from the south or south west during September 2001 but far more often in August and October when the sea level anomalies were respectively 115mm and 95mm higher

[21] see http://www.bom.gov.au/nmoc/MSL/index.shtml

than the sea level anomaly for September. This shift in winds might therefore account for the irregular spikes in the graph in Figure 6-3

Overall though, the sea levels correlate reasonably well to the Southern Oscillation Index (SOI). Figure 7-4 shows a graph of the 4-station average sea level anomaly and the SOI. The graph is of 5-month averages (previous 2 months, current and next two months) for both factors because both are prone to short-term fluctuations caused by transient events, in one case wind and in the other tropical rain patterns. Not even the averaging over 5 months entirely removes the short-term spikes and where two spikes occur in short succession, such as August and October 2001, they have an inevitable impact on the averages.

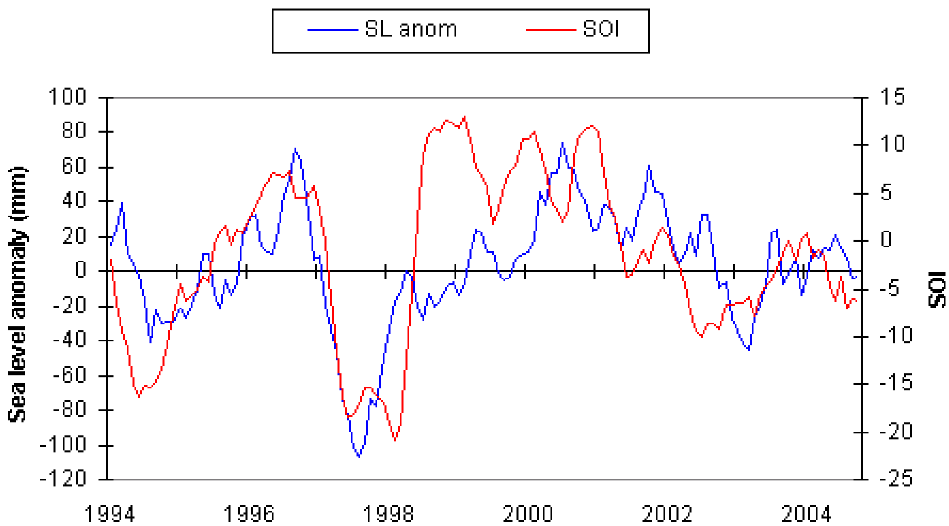

Figure 7-4. 5-month averages of the 4-station average sea level anomaly and the Southern Oscillation Index (SOI)

When sea level recordings across periods of subsidence and uplift of monitoring stations are removed from the dataset the greatest influence on Victoria's sea level is the ENSO system in the Pacific Ocean. It also appears very likely that onshore winds from the south and south-west play a critical part as they help push the ocean water onto the coast and probably, in the cases of Geelong and Williamstown, into Port Phillip Bay where they spread in all directions.

The above finding is consistent with Kolker and Hammed (2008)[22] in which it was found that "a large fraction of the annual mean sea-level variability at the five Atlantic Ocean stations" is correlated with shifts in the position and intensity of the COAs," where a COA ("centre of action") is a term they use for an atmospheric pressure cell in the Atlantic (eg. Azores High, Icelandic Low).

[22] Kolker, A.S. and Hameed, S. 2007. Meteorologically driven trends in sea level rise. *Geophysical Research Letters* **34**: 10.1029/2007GL031814

8. Ocean Acidity

In recent years claims have sprung up about the acidity of oceans increasing as a consequence of an increase in atmospheric carbon dioxide. These deserve a response because clearly they have alarmed some people.

The pH is a measurement of acidity of a liquid solution and ranges from 1 to 14 with the low values acidic and the high values alkaline.

First it needs to be said that the oceans contain far more carbon dioxide than the atmosphere. It is estimated that the atmosphere contains about 700 gigatonnes (Gt) of carbon, the ocean surface layer about 600Gt, an intermediate ocean layer about 7000Gt and the deep ocean about 30,000 Gt, and the ocean sediments about 1,000 times more than the deep ocean.

Not only is the carbon dioxide constantly being exchanged with the atmosphere but it also undergoes chemical change into other substances - some liquid (eg. carbonic acid) and some solids - and those processes may involve many steps. One example of these processes is the carbon dioxide being a nutrient for plankton, that is then eaten by larger marine creatures, that use the carbon to form calcium carbonate for their skeletons or shells, and when the creature dies the carbonate falls to the ocean floor where it becomes part of the sediment that ultimately forms limestone, which can transforms into other rock types.

The common perception is that oceans absorb carbon dioxide from the atmosphere but that is the only net effect of a constant exchange of carbon dioxide molecules between the sea's surface and the air. This exchange is influenced by wind because wind causes larger waves and increases the ocean spray, both of which increase the sea surface exposed to the atmosphere.

The temperature of the ocean's surface also influences the exchange. Measurements of carbon dioxide at Mauna Loa (Hawaii) show that more carbon dioxide remains in the atmosphere during El Nino events and that's when ocean surface temperatures rise.

The transfer of atmospheric carbon dioxide into an acid in the ocean is a complex process that appears to involve plankton using the carbon dioxide as a nutrient. As with land-based plants, the chemical processes within the plankton differ according to exposure to light (day and night, cloud and sunlight) and with shifts in temperature (short-term or seasonal), so the process will be to some extent climate dependent.

The acidity of the oceans is not constant (see Figure 8-1). Acidity varies with the depth and in this figure the highest acidity is where upwelling cold water brings water rich in carbon dioxide to the surface and the lowest is in the calm regions at the centre of ocean gyres (large circular surface currents). The key appears to be the mixing of surface water with deeper layers. A very small increase in water mixing would probably have the same effect on acidity as many years of anthropogenic emissions into the atmosphere. The deep layers of cold water are more acidic and contain less oxygen but are very rich in nutrients for plankton and fish.

As observed above, temperature, wind and ocean currents have an impact on carbon dioxide absorption and hence on ocean acidity. As with many chemical reactions the temperature plays a vital part and here it will vary as warmer waters expel carbon dioxide.

The data for Figure 8-1 was probably obtained over a lengthy period of time and with a variety of weather and climate conditions so the figure itself should be treated with some caution.

The measuring of ocean acidity at any time will need to take into account these climate issues factors as well as the fact that the accuracy of pH meters varies with temperature.

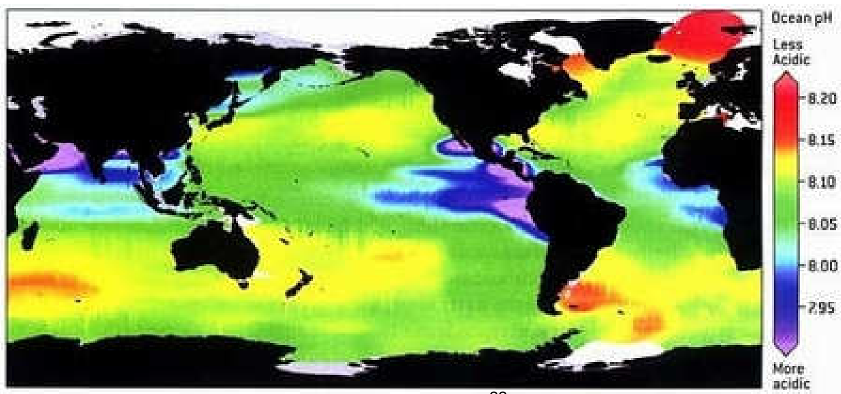

Figure 8-1. Ocean acidity according to Doney (2006)[23]

It is claimed that ocean acidity has increased since pre-industrial times. We have to ask whether that pre-industrial pH level was measured or merely based on computer models of ocean acidity. If it is the latter then we need to be sure that the models were accurate and complete, and that any assumptions were reasonable.

If the pre-industrial pH levels were obtained by measurement then we should ask how accurate the measuring techniques were at the time and how widespread the recordings were. In the late 1700s the Pacific Ocean and the polar regions were still being explored and so comprehensive monitoring of ocean acidity seems unlikely.

One of the few substantial studies of acidity involved two research voyages in the Pacific about a decade apart. After the second voyage it was claimed that ocean acidity had increased 0.025pH. Determining that figure would require high quality instruments but were the same instruments used for the samples taken in both voyages? The pH of the water will vary with temperature and with water mixing so we need to know whether temperature, wind and any recent storms were properly taken into account.

One of the above important factors is wind and other researchers have claimed that it is important in determining the temperature of the ocean surface, which for us here means the absorption of atmospheric carbon dioxide but for them was in relation to coral bleaching. Despite the important role that wind might play in these matters there is remarkably little data available for wind speed and direction in either a historical or current context.

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[23] Doney, S.C. (2006) The Dangers of Ocean Acidification, *Scientific American*, Mar 2006, vol 294, no. 3, p58-65

Many uncertainties exist about acidification as a whole and about its possible consequences. The carbon cycle is poorly quantified with respect to flux (i.e. movement between air and sea, or sea surface and deep layers) and to total stocks. Scientists might know atmospheric concentration with reasonable precision but deep ocean stores are only estimated to thousands of gigatonnes. The influence on ocean chemistry of the carbonate deposits on the sea bottom is poorly understood and scientists are only starting to investigate the short and long-term impact of possible acidification on the health of marine organisms and their vulnerability, resilience and adaptability.

Claims about increased ocean acidification due to anthropogenic emissions of carbon dioxide are becoming more common but there are two fundamental contradictions that need to be reconciled, namely:

(a) Deep ocean waters, which contain more carbon dioxide and are more acidic, provide nutrients for plankton and hence for fish and other marine animals to the extent that the regions of upwelling cold water are recognised as good fishing grounds. This suggests that an increase in acidity might be beneficial to marine life.

(b) It is widely claimed that an increase in atmospheric carbon dioxide will cause atmospheric temperatures to rise. The oceans are less effective at absorbing carbon dioxide when the sea surface temperatures are elevated and so any change in ocean acidity will be retarded by increases in atmospheric temperature.

Claims about increased ocean acidification should therefore not be accepted without proper scientific scepticism about methods, interpretations and conclusions, and of course with a healthy regard for what is uncertain about the process and for contradictions against wider issues.

9. Comments and Recommendations

Comment 1 - This document relied upon Victoria-wide meteorological data because the relevant detailed data is not freely and easily available for investigations of variations in climate along coastal Victoria.

Recommendation 1 - Request that the State Government makes such data freely and readily available to authorities like the Victorian Coastal Council.

Comment 2 - No evidence of a human influence on climate can be identified in data for eastern Australia. The likely cause of the observed change in climate is the Great Pacific Climate Shift and the consequent change in the El Nino-Southern Oscillation (ENSO) system.

Recommendation 2 - Ensure that any climate data presented as long-term trends is split into parts before and after that shift so that any effects of the shift itself are excluded.

Comment 3 - The shift in the ENSO system has moved the Pacific towards a "mid-point" state of "semi-El Nino" and this has major consequences for temperature and rainfall in eastern Australia. Coastal Victoria is on the edge of that ENSO sphere of influence and steps should be taken to mitigate against the impacts. (There is also some prospect of additional migration to coastal Victoria by people who currently live in marginal areas that are under threat from a long-term reduction in rainfall.)

Recommendation 3a - Take all possible action to ensure that water supply is sufficient for the coastal region. This might include large desalination plants and extensive networks of pipes or a number of smaller plants serving local communities. The system offered by Ceto Pty Ltd - see http://www.ceto.com.au -has the advantages of being wave driven, invisible from land and in times of adequate rainfall could be optionally be used to gain revenue by generating electricity that could be fed into Victoria's grid to generate funds.[24]

Recommendation 3b - Water recycling is to be encouraged either as a supplement to fresh water supplies or for purposes other than direct contact with humans.

Recommendation 3c - Steps should be taken to reduce the threat of fire. These should include education and logistics issues such as the maintenance of access tracks so that any fires can be quickly addressed.

[24] I have no financial interest whatsoever in Celco.

Comment 4 - The question of changing patterns of extreme weather events is very difficult to answer especially in these current times of "weather paranoia" when news of every slightly abnormal event is broadcast widely.

Recommendation 4 - Undertake detailed research from records of weather observations and from local newspaper reports in order to determine if/how patterns of extreme events have changed. I suspect that no significant changes of pattern have occurred, but research is needed to confirm or refute that.

Comment 5 - Sea-level along Victoria's coastline is very much driven by ENSO conditions and probably by onshore winds. The data indicates no forces that increase over time in a manner consistent with rising land-based temperatures or levels of atmospheric carbon dioxide. ENSO conditions shifted towards El Nino back in 1976 and since these conditions correspond to lower sea level, a general decrease should have occurred over the last 30 years, unless of course subsidence or uplift of tidal monitoring stations has masked this change.

Recommendation 5 - Do nothing because no action is warranted. Sea levels will rise and fall in accordance with ENSO conditions and wind patterns. If this is unpalatable then consider engaging the services of sea level expert Professor Nils-Axel Mörner in order to conduct a physical inspection of Victoria's coastline for signs of changes in sea level.

Comment 6 - An increasing number of claims are being made with respect to ocean acidification as a consequence of anthropogenic emissions of carbon dioxide.

Recommendation 6 - Examine each of those claims on their merits (e.g. accuracy of research, feasibility of conclusions) and within the wider context of knowledge about the carbon cycle. Be vigilant but do not rush to be alarmed by such claims, also put those claims into the context of coastal management.

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