Why Global Warming Does Not Threaten Dangerous Temperatures

"Truth is the daughter of time, not of authority."
Francis Bacon (1561-1626)

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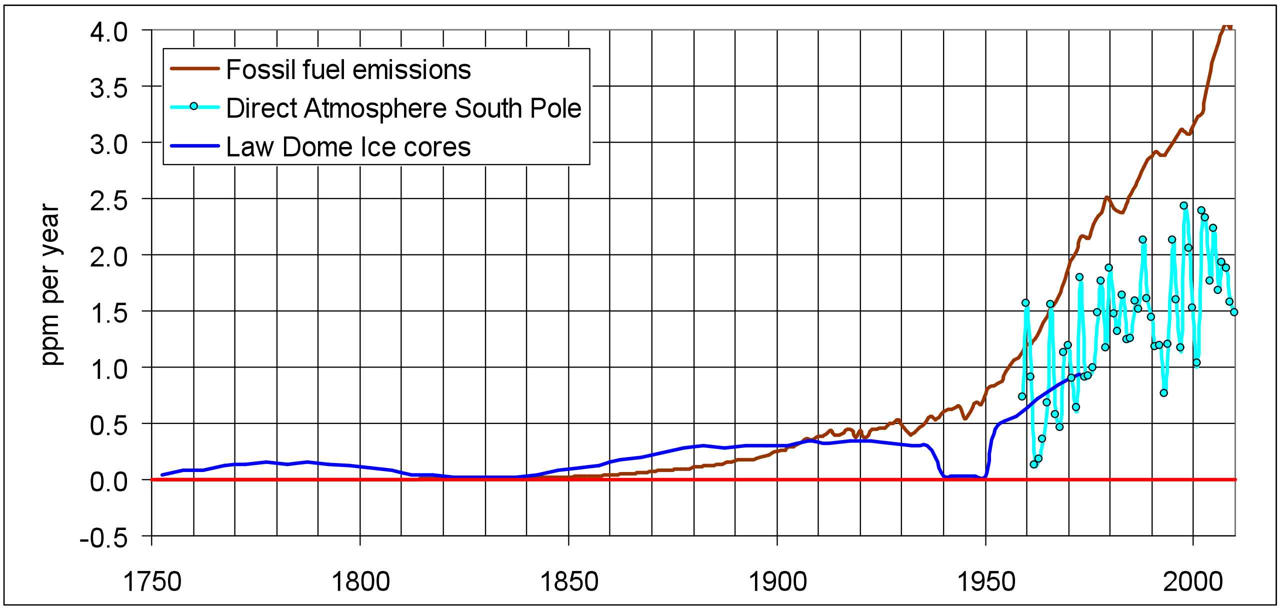
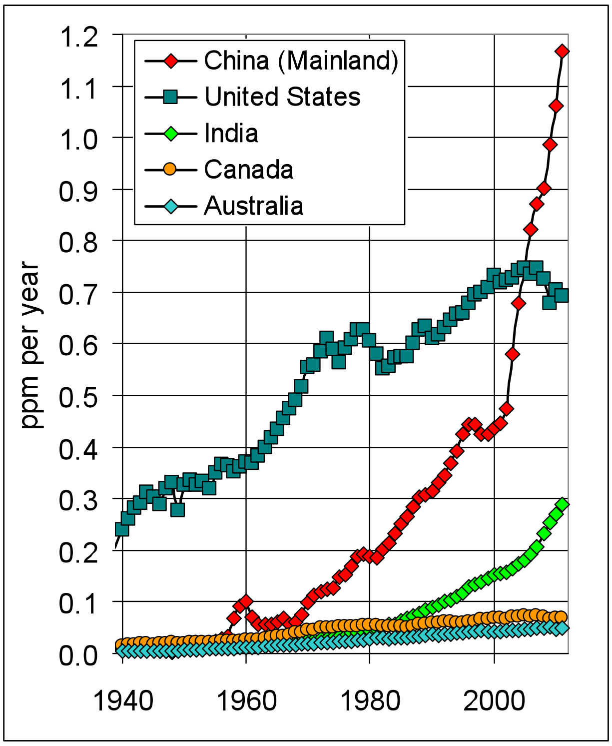
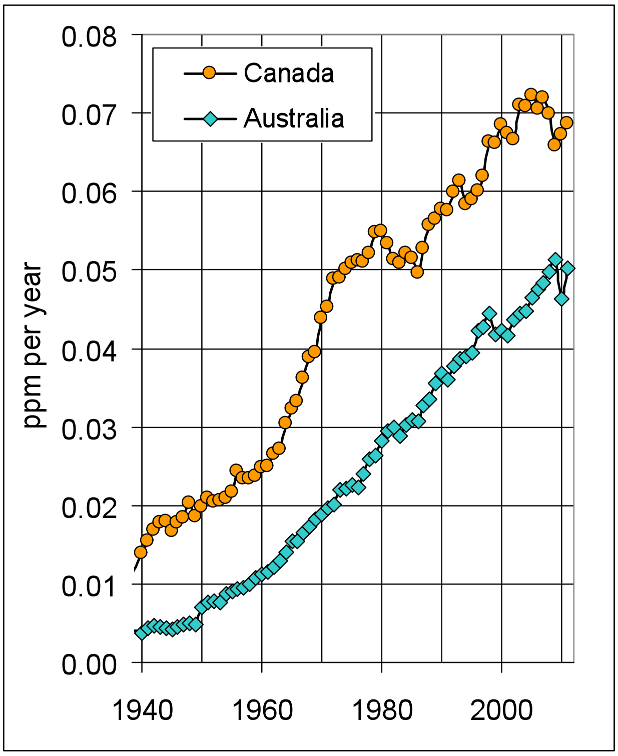


Figure 1: *Annual changes for fossil fuel and cement production emissions (**brown line**), directly measured changes in atmospheric CO_2 concentrations at the South Pole (**light blue line**) and ice core measurements of CO_2 at the Law Dome in Antarctica (**dark blue line**). Sources – Scripps Institute of Oceanography and CSIRO*

Starting with the industrial revolution, the annual increases in atmospheric CO_2 concentrations remained above the estimated fossil fuel emissions until the 1920s. The difference was understood to be due to land use changes. Since the direct measurements commenced in 1958, it is estimated that 55% of fossil fuel emissions remain in the atmosphere (IPCC reports).

Note that through the 1940s there was no apparent rise in CO_2 concentrations.





China is now emiting as much in one year as Australia's total fossil fuel emissions.

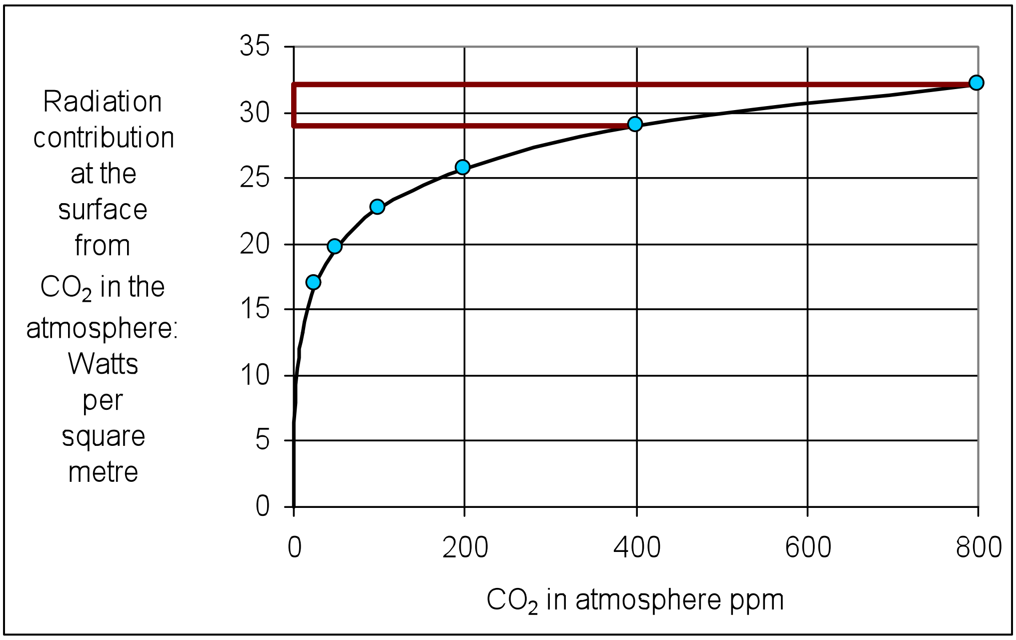


Figure 2: *As the concentration of CO_2 increases, there is increased radiation back to the surface of the earth (the greenhouse effect). This is measured in Watts per square metre (left axis). However the relationship is not linear. In fact doubling the concentration of CO_2 from 400 ppm to 800 ppm only increases the radiation from CO_2 at the surface by some 10% or 3.2 Watts per square metre. (Results derived for US standard atmosphere and cloudless sky from MODTRAN, a University of Chicago on-line calculator of energy in the atmosphere. MODTRAN is an international and IPCC accepted standard for atmospheric calculations).*

All the projections of future temperatures, sea levels, rainfall and disasters are the results of computer modelling. The critical inputs can grouped into four components:

1. **Present and past measurements of variables describing the behaviour of the atmosphere and oceans.**
   This is the starting point for understanding and important in verifying model calculations. In general the measurements are 'state-of-the-art'. Proxy data can be problematic. An example is tree ring analysis and the arguments over the Medieval Warm Period.
2. **Estimating the variations of sources and sinks for green house gases**
   There is considerable difficulty in identifying all sources and sinks for green house gases. The problems of understanding the variations in methane (Figures 12 and 13) illustrate the uncertainties in understanding sources and sinks of green house gases. The structured increases in CO_2 (Figures 6 and 7 and Table 1) indicate the important role of the oceans in setting CO_2 levels in the atmosphere.
3. **Coupling the oceans to the atmosphere**
   The oceans are 70% of the surface of the earth and have as much mass in their top 10 metres as the entire atmosphere. The changes in ocean surface temperature are a key determinant of global temperature. The recent climate models couple the oceans to the atmosphere. However the consequences of decadel oscillations of ocean surface temperature (Table 1) have largely been ignored since their occurrence and extent is not understood.
4. **Climate sensitivity**
   Climate sensitivity is how much warming is expected from a given change in CO_2. There is general agreement that more CO_2 in the atmosphere will increase the temperature at the surface of the earth. **A simple doubling of the CO_2 will give a temperature increase of less than 1^0C. The IPCC projections of greater increases from 2^0C to 4.5^0C are a consequence of positive feedback that follows the IPCC estimated radiative forcing**

ISOTOPES OF CARBON DIOXIDE

An isotope is any of two or more forms of a chemical element, having the same number of protons in the nucleus, or the same atomic number, but having different numbers of neutrons in the nucleus, or different atomic weights. There are two stable isotopes of carbon, carbon-12 (C12) and carbon-13 (C13). C12 has 6 protons and neutrons while C13 has 6 protons and 7 neutrons. Since the rate of chemical reactions and physical processes is greater for lighter isotopes, all other things being equal, enrichment and depletion of carbon isotopes occurs. For plants, photosynthesis has 2 pathways that lead to different depletion levels of C13 fixed in plants.

The various sources of atmospheric CO_2 have quite distinctive isotopic compositions (see *Footnote 1*).

The isotopic composition of atmospheric CO_2 has been measured since 1978 by Scripps. By combining the measurements of CO_2 concentrations and isotopic composition, it is possible to separate contributions from plants, whether on land or in the oceans, and contributions from the oceans.

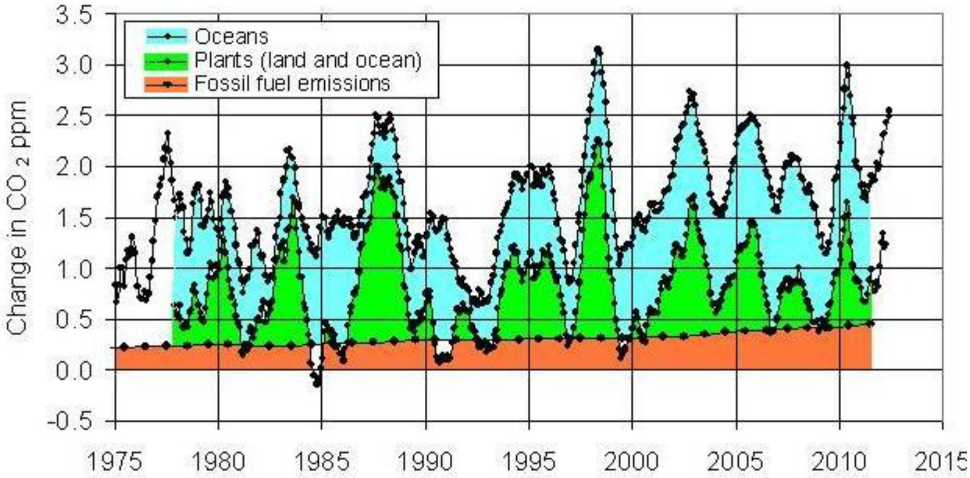


Figure 3: *5 month running averages for total annual CO_2 increases and the **l**and and ocean plant component of the annual CO_2 increases assuming $\delta^{13}C$ = -26 for land. Also 10% of global fossil fuel and cement production emissions making up 19% of the average annual increase in CO_2 (Source CDIAC*

This preliminary analysis shows that after allowing for uncertainties less than 16% of fossil fuel emissions are found in the "well-mixed" atmosphere whereas the present accepted figure is 55% (Figure 1). The detail is shown in Figures 3B and C with separate land and ocean contributions

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Footnote 1:

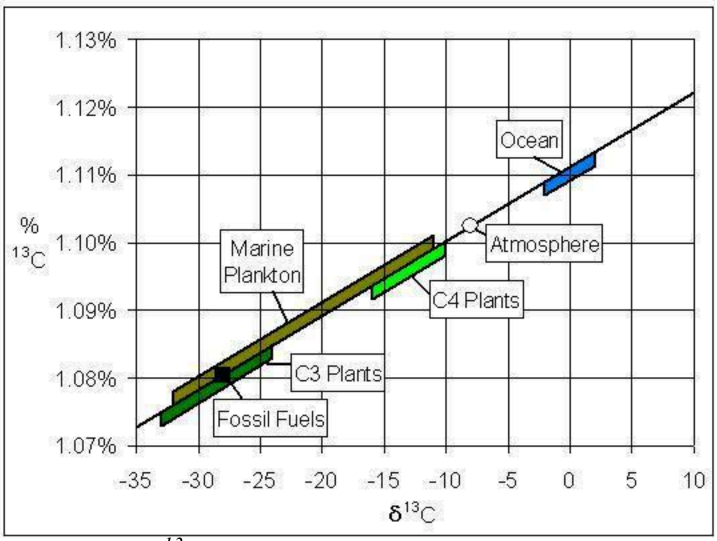


Figure R1: *$\delta^{13}C$ as a percentage of Carbon-13 in carbon*

TEMPERATURES MEASUREMENTS

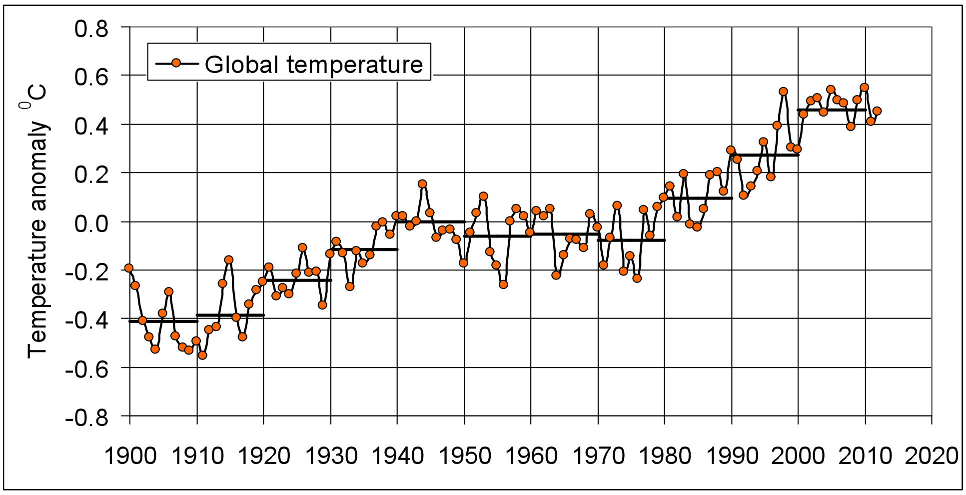


Figure 4: *Annual global temperatures from the Hadley Centre and the Climate Research Unit of the University of East Anglia (CRU). Here solid lines show ten year averages. Note the loss of detail in ten year averages such as the 1997-98 El Nino. (Source Hadley-CRU 2013)*

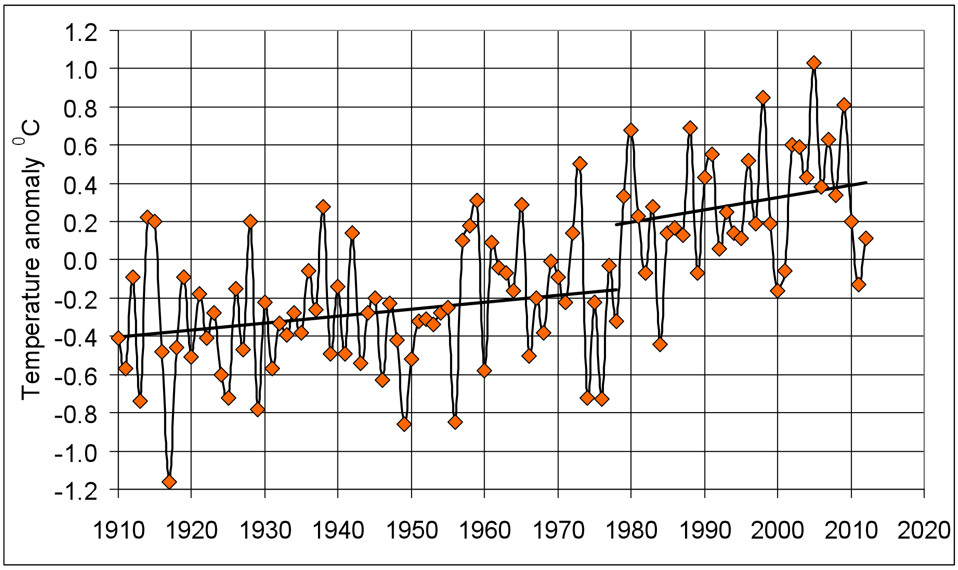


Figure 5: *Annual Australian temperatures from the Bureau of Meteorology (BOM) high quality data series. The break and jump in the solid lines of 0.4^{0}C is a consequence of the Pacific Decadal Oscillation moving from a cool to a warm phase, often called the Great Pacific Climate Shift of 1976-78 that is also reflected in the global temperature.*

Annual average Australian temperatures compiled by the BOM from high quality data that has been adjusted from the actual measured data to take account of changes in measurement technology and place of recording. The average is calculated solely from the minimum and maximum temperatures. Hadley CRU temperatures also use the average of the minimum and maximum temperatures

There is evidence suggesting that the adjustments by the BOM may have a significant upward bias. However, even using the BOM adjusted figures we find that the jump in the solid lines between the two periods covered show a 0.4 ^{0}C increase in average temperatures that must be largely if not entirely attributable to natural changes as there was no comparable jump in atmospheric CO_2 concentrations at that time.

In fact, in 1976-78 there was a major transformation in sea surface temperatures due to a sudden replacement of cold water with warm water along the west coast of North America and the equatorial eastern Pacific (in 1997 researchers identified a multi-decadal oscillation in Pacific sea surface temperature and pressure, which they called the Pacific Decadal Oscillation). The implication is that half of the increase of about 0.8 ^{0}C in temperatures in Australia during the last century reflected natural changes and that there is no validity in temperature prediction models that assume the increase reflected fossil fuel emissions.

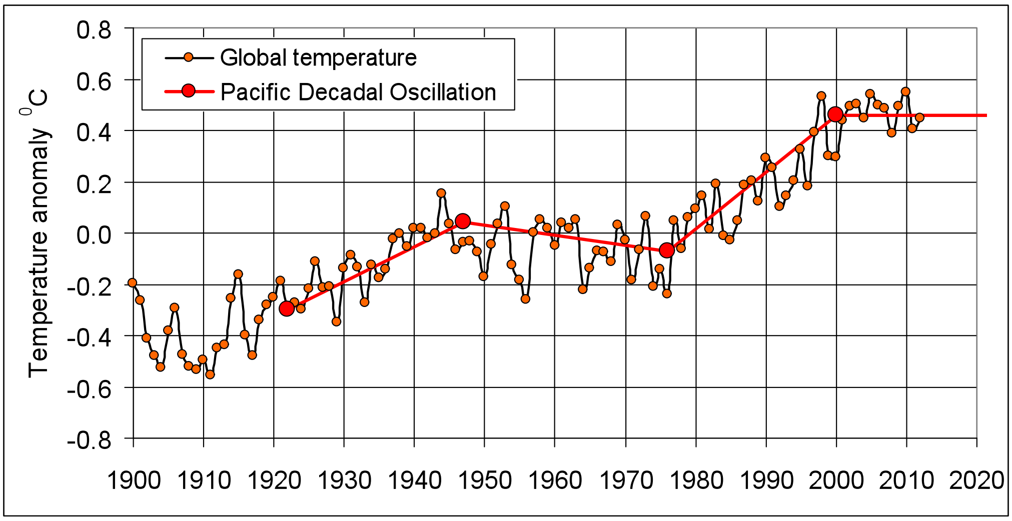


Figure 6: *Annual global temperatures from the Hadley Centre and the CRU. Here solid lines show ten year averages. The* ***red points*** *mark the phase changes of the Pacific Decadal Oscillations.*

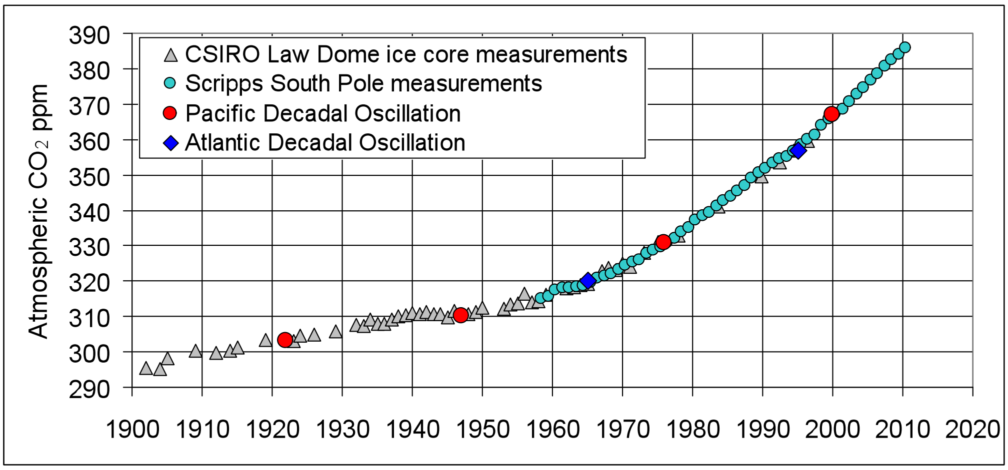


Figure 7: *Atmospheric CO_2 concentrations measured in ice cores at the Law Dome in Antarctica (CSIRO) and directly at the South Pole (Scripps Institute of Oceanography). The* ***red*** *and* ***dark blue points*** *mark the phase changes of the Pacific and Atlantic Decadal Oscillations including a probable change in 2000.*

The oceans cover 70% of the surface of the earth. The top 10 metres of the ocean have the same mass as the entire atmosphere. The oceans are a heat store for the planet and have a compelling influence on the atmosphere. The Pacific and Atlantic Decadal Oscillations are an expression of this influence.

The Pacific Decadal Oscillation appears to have the more powerful atmospheric influence as both temperature and CO_2 respond to the changing phases. There is no close relationship of temperature with CO_2 for either warm or cool phases of the Pacific Decadal Oscillation.

Table 1: Variations in temperature and atmospheric CO_2

PERIOD	Pacific Decadal Oscillation Phase	Global Temperature °C increase per 10 years	CO_2 at the South Pole Annual increase in ppm
1922 - 1947	Warm	0.13 +/- 0.02	0.40 +/- 0.03
1948 - 1976	Cool	-0.02 +/- 0.03	0.85 +/- 0.03
1977 - 2000	Warm	0.16 +/- 0.03	1.49 +/- 0.01
2000 - 2012	Cool?	-0.02 +/- 0.04	1.93 +/- 0.03

Clearly the connection of temperature and CO_2 concentrations is not simple

TEMPERATURE ADJUSTMENTS

There are two problems with the definition of **T**mean = ½(**T**minimum + **T**maximum) but the minimum and maximum temperatures constitute the historical record.

- First, does the average of minimum and maximum temperatures represent the mean temperature over a full day of 24 hours? The answer is that it does not. There is up to a 0.6 ^{0}C systematic error

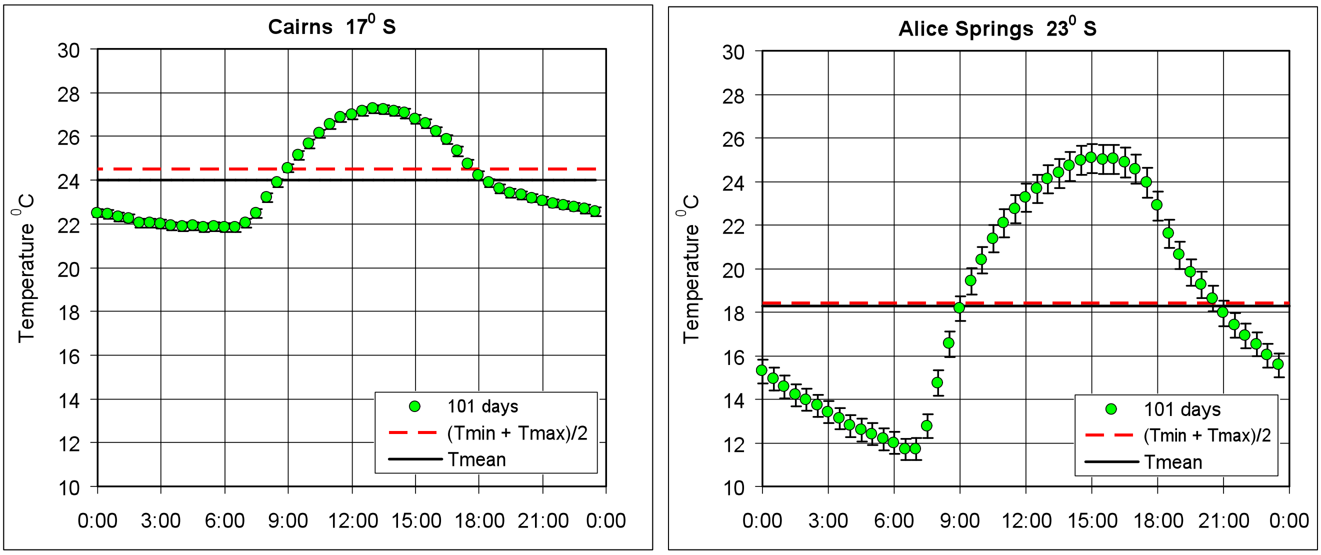


Figure 8: *Temperatures measured at 30 minute intervals through a 24 hour day.*

The sample in Figure 8 is for 101 days from March to June 2013 and the error bars are the standard errors of the mean. The difference for (Tmin + Tmax)/2 - Tmean is **0.01 +/- 0.06** for Alice Springs and **0.55 +/- 0.04** for Cairns.

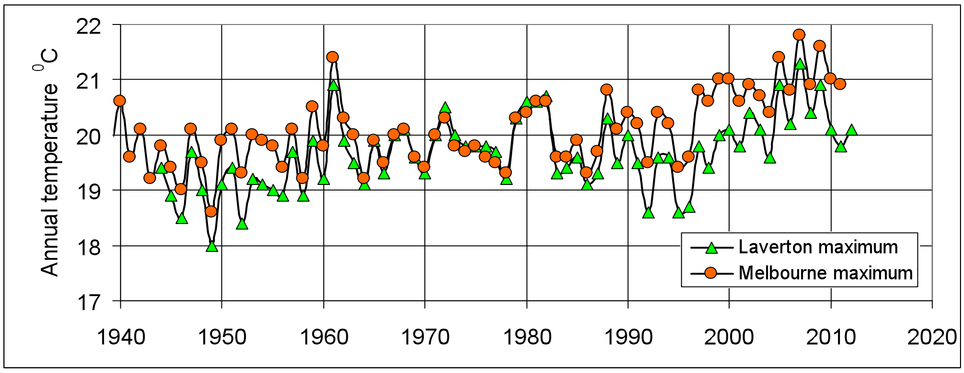
The centre of the Australian continent has a desert climate and the Alice Springs location has a desert temperature behaviour that is representative of much of central Australia from Kalgoorlie to Broken Hill. On the other hand Cairns temperatures represent both coastal and inland areas where the humidity is greater than in central Australia.

- Second, minimum and maximum temperature thermometers record the extremes through a twenty four hour day. A comparison of the extremes with temperatures read every 30 minutes through the day shows the presence of a systematic error. The average error from the use of 24 hour thermometer readings is an increase in mean temperature of **0.13 +/- 0.01 ^{0}C**. This is an over-estimate of all mean temperatures calculated from the use of minimum and maximum values.

This systematic error is a consequence of the "one-way" temperature recording where, for example, a 10 minute 1^{0}C fluctuation increasing temperature would give a 0.5^{0}C increase in the average of minimum and maximum "mean" temperature rather than the properly weighted 0.01^{0}C change.

These are serious and un-addressed systematic errors which give a significant upward bias to continental and global land temperatures. Ocean temperature measurements are recorded in a quite different manner.

There is a further problem that arises from adjustments made to get the "high quality" Australian temperatures. It is the "urban heat island effect". A comparison of the BOM office site in central Melbourne and Laverton airport illustrates the problem. Laverton is some 18 km from the BOM office site in Melbourne.



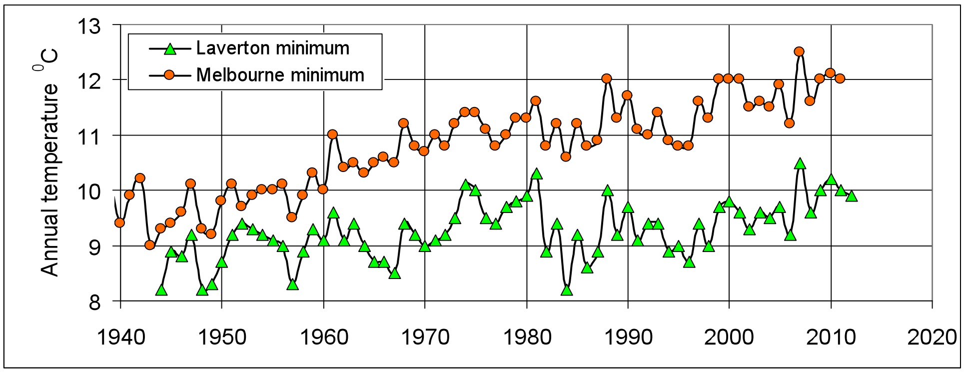


Figure 9: *BOM records of direct maximum and minimum temperatures at the BOM office in central Melbourne and at Laverton airport.*

For the minimum temperature at Laverton, there is a very significant difference to Melbourne in both temperature and trend over the same period. While there is a modest minimum temperature increase at Laverton of 0.13 +/- 0.03^{0}C per decade, the increase in Melbourne is 0.35 +/- 0.02^{0}C per decade

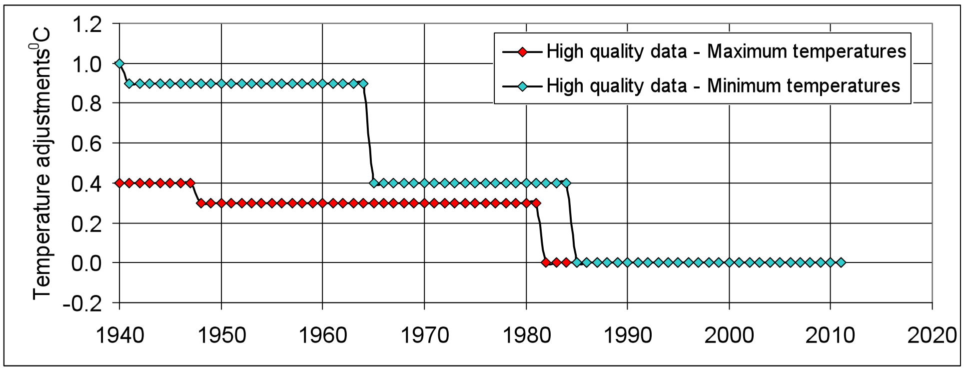


Figure 10: *Adjustments made to the direct BOM Melbourne office temperature records to give "high quality" BOM temperature records.*

The minimum temperatures occur just at or before sunrise, when the only sources of warmth are carried in the atmosphere or are radiated by buildings close to the recording thermometers. The BOM documents the changes in the surroundings of their site at the corner of Victoria and LaTrobe Streets but the adjustment figure above for the minimum temperature shows no hint of urban heating coming from the changes to the surroundings -- quite the reverse, in fact.

There are serious and un-addressed systematic errors in the over-estimation of continental and global temperatures. These errors are of the same size as the present adjustments.

VERIFICATION OF COMPUTER MODEL PREDICTIONS

The IPCC estimates of forcing are not supported by a number of experimental analyses. An example of this is the climate models' prediction that global precipitation will increase at a rate of 1-3% per degree rise in temperature. A recent analysis of satellite observations (Wentz 2007) does not support this prediction. Rather, the observations show that precipitation has increased at about 6% per degree rise in temperature over the last two decades. This result indicates reduced rather than increased temperature compared to the simple increase illustrated in Figure 2.

Roy Spencer's comparison of models and measurements:

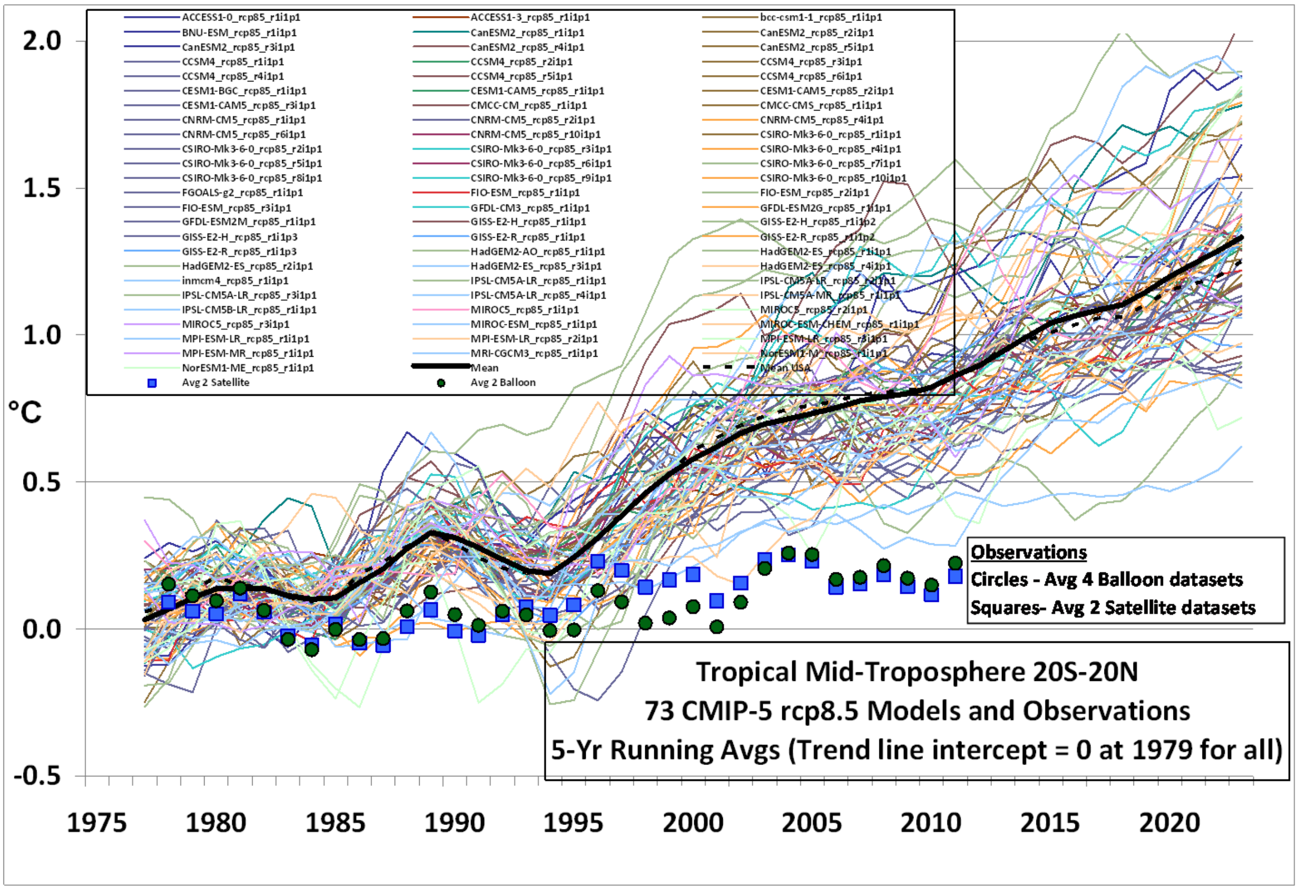


Figure 11: *A comparison of modelled and measured temperatures by Roy Spencer, University of Alabama at Huntsville. The continuous solid line is the average of 73 model projections. The green circles and blue squares are balloon and satellite measurements.*

None of the models projected measured temperatures.

CSIRO measurements and analysis of methane extracted from ice cores at the Law Dome in Antarctica. Direct measurements in the atmosphere come from CSIRO station at Cape Grim on the northwest corner of Tasmania. The data for these two figures comes from the CSIRO. This includes the smoothing of the data. All the methane data can be found on the Carbon Dioxide Information Analysis Center http://cdiac.ornl.gov/by_new/bysubjec.html#atmospheric . The only additional data handling has been to calculate the annual increase in methane concentrations.

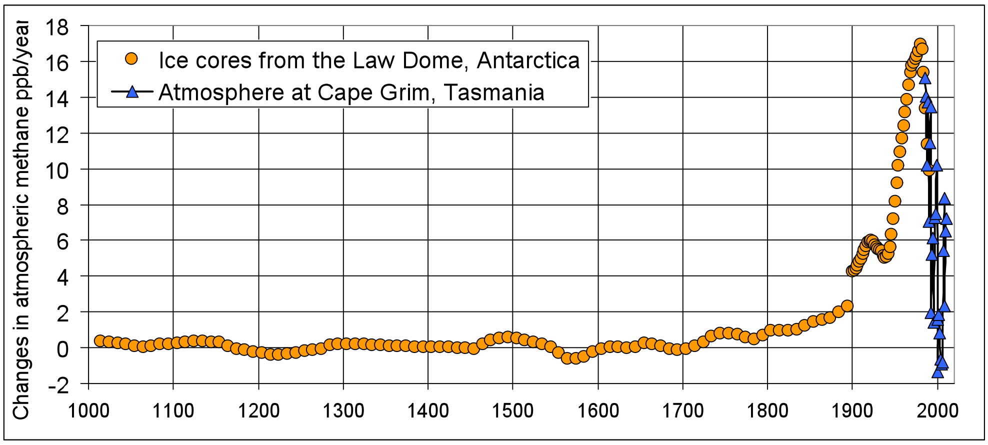


Figure 12: *Ice core and direct measurements of atmospheric methane. Data source CSIRO*

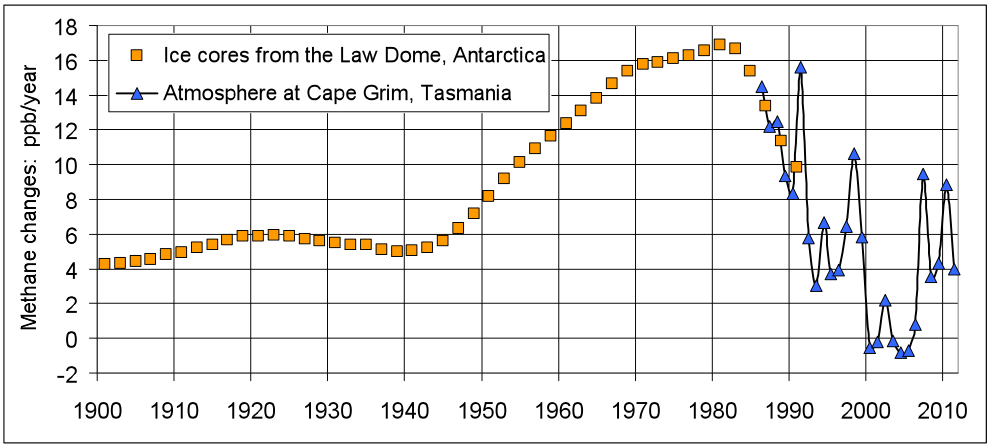


Figure 13: *Ice core and direct measurements of atmospheric methane from 1900. The peaks in the direct measurements correspond to El Ninos with the exception of 1992 which is an indirect result of the Mt Pinatubo eruption. Data source CSIRO.*

Table 2: Annual increase in atmospheric methane

From year / To year	1000–1750	1750–1800	1800–1850	1850–1900	1900–1950	1950–1960	1960–1970	1970–1980	1980–1990	1990–2000	2000–2011
Methane ppb/year	0.05	0.63	1.00	1.63	5.36	10.00	13.85	16.11	15.76	7.22	2.54

The annual increase in atmospheric methane is at about the rate of the early part of the nineteenth century. An explanation for the rise in methane from the 1940s to the 1980s is the expanding consumption of natural gas and its leakage from pipelines, particularly in the old Soviet Union. The steep fall at the end of the 1980s and early 1990s occurred as the leakage was greatly reduced and since that time variations follow a natural pattern showing El Ninos.

In the IPCC fourth report, Scenario A1FI gave the projected rise in methane as 8 ppb/year to year 2100, a factor of 4 times the last 10 years. The CSIRO uses scenario A1FI for many of their computer model forecasts.

MURRAY-DARLING BASIN YEARLY RAINFALL 1900 TO 2012

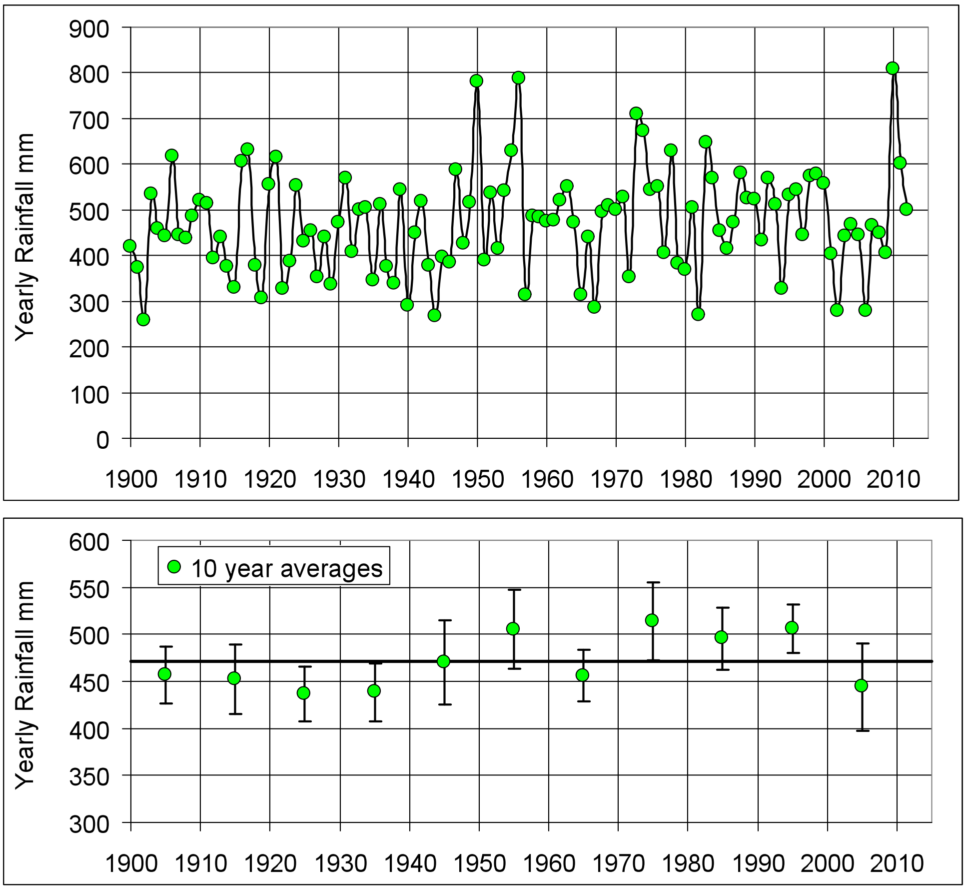


***Figure 14: Upper**: Yearly and **Lower** 10 year average rainfall in the Murray-Darling Basin. Mean value (solid line) and median are 471 mm. There is no significant trend in rainfall through this period but with large variability- standard deviation of 111 mm with rainfall extremes of a minimum 258 mm and a maximum of 809 mm in 2010*

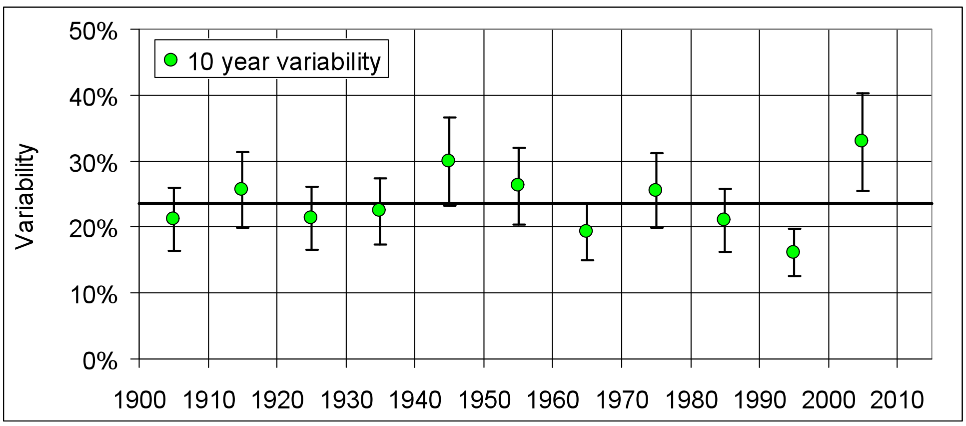


***Figure 15:** Murray Darling Basin variability. Variability is the rainfall standard deviation divided by mean rainfall for 10 year periods. Solid line is the overall variability of 24%.*

There results do not provide any support for the climate model projections of less rainfall and more variability.

The 1963 study by Sir Samuel Wadham of Australian climate over 75 years compared with overseas concluded that “nowhere in the world is there such a huge area of pastoral land of such erratic rainfall”.

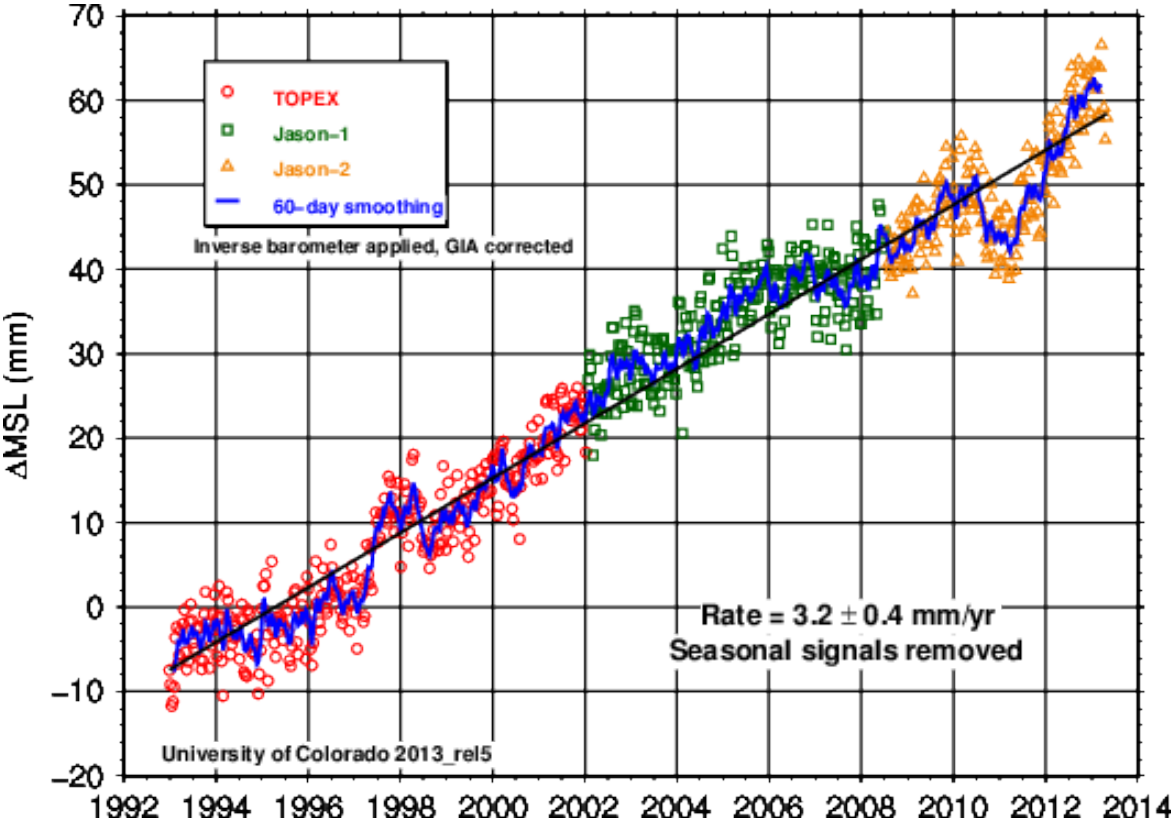


Figure 16: *The global mean sea level graph was made using satellite altimetry and processed by the University of Colorado at Boulder. Note that the rate of increase is 3.2 +/- 0.4 mm/year for1992 to 2012 but falls to 2.6+/- 0.3 mm/year for 2002-2012. If the rate of increase continues at about 3 mm a year, sea levels would reach about 30 cm in 2100. That is consistent with the IPCC's projection of 19-59 cm by 2100 and would not involve any significant inundations.*

Over the last century, global sea level changes were obtained from tide gauge measurements by long-term averaging. The increase over the period to 1990 was estimated at 2 mm per year.

Since August 1992 the satellite altimeters have been measuring sea level on a global basis with unprecedented accuracy using precisely known spacecraft orbits. The TOPEX/POSEIDON (T/P) satellite mission provided observations of sea level change from 1992 until 2005. Jason-1, launched in late 2001 as the successor to T/P, continues this record by providing an estimate of global mean sea level every 10 days with an uncertainty of 3-4 mm. The latest mean sea level time series can be found on this site.

There is some criticism of the processing of the satellite data with an analysis (N Morner 2011) showing that land uplift and subsidence corrections to tide gauges have increased the sea level rise by 1 to 2 mm per year.

A "draft" of AR5 by the IPCC predicts an increase by 2100 of 29-82cm compared with the IPCC AR4 prediction of 19-59cm. An increase of 3mm a year would lead to an increase by 2100 at the bottom end of the IPCC AR5 projection range of 29-82cm.

CHANGES IN SOUTHERN AND NORTHERN ICECAPS

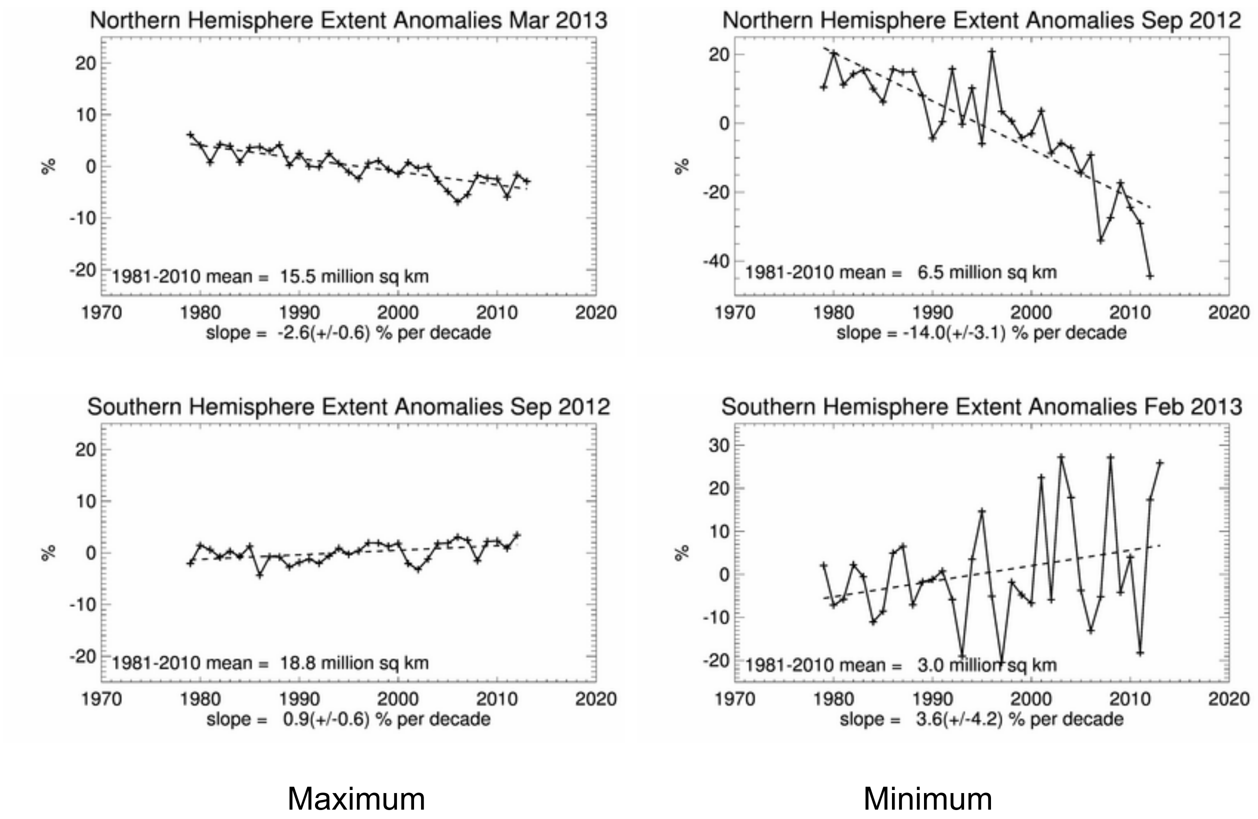


Figure 17: *Arctic and Antarctica ice extent. The maximum extent occurs in March in the Northern Hemisphere and in September in the Southern Hemisphere, summer minima occur in September and February. The Northern Hemisphere ice extent is decreasing with reducing maximum and minimum extent. Note that the slopes for the fitted straight lines give the change per decade.*

Data from National Snow and Ice Data Center: http://nsidc.org/data/seaice_index/

The 30 year net global changes in maximum and minimum ice extent are -0.1 +/- 0.1 million sq km and -0.4+/- 0.2 million sq km.

This is not a statistically significant change.

Receding ice is not a new phenomenon.

In 1903, Amundsen led the first expedition to successfully traverse Canada's Northwest Passage between the Atlantic and Pacific Oceans.

In 1922 the US Weather Bureau reported “The Arctic Ocean is warming up, icebergs are growing scarcer and in some places the seals are finding the water too hot. Reports all point to a radical change in climate conditions and hitherto unheard-of temperatures in the arctic zone. Expeditions report that scarcely any ice has been met with as far north as 81 degrees 29 minutes. Great masses of ice have been replaced by moraines of earth and stones, while at many points well known glaciers have entirely disappeared.”

GLOBAL MEAN RADIATIVE FORCING

Radiative forcing is used to assess and compare the anthropogenic and natural drivers of climate change. The many factors influencing temperature, both positively and negatively, are categorised under the title 'Radiative forcing' and the effects of each influence are naturally subject to margins of error. The IPCC publishes the following graphic (Fig 18) showing the various influences.

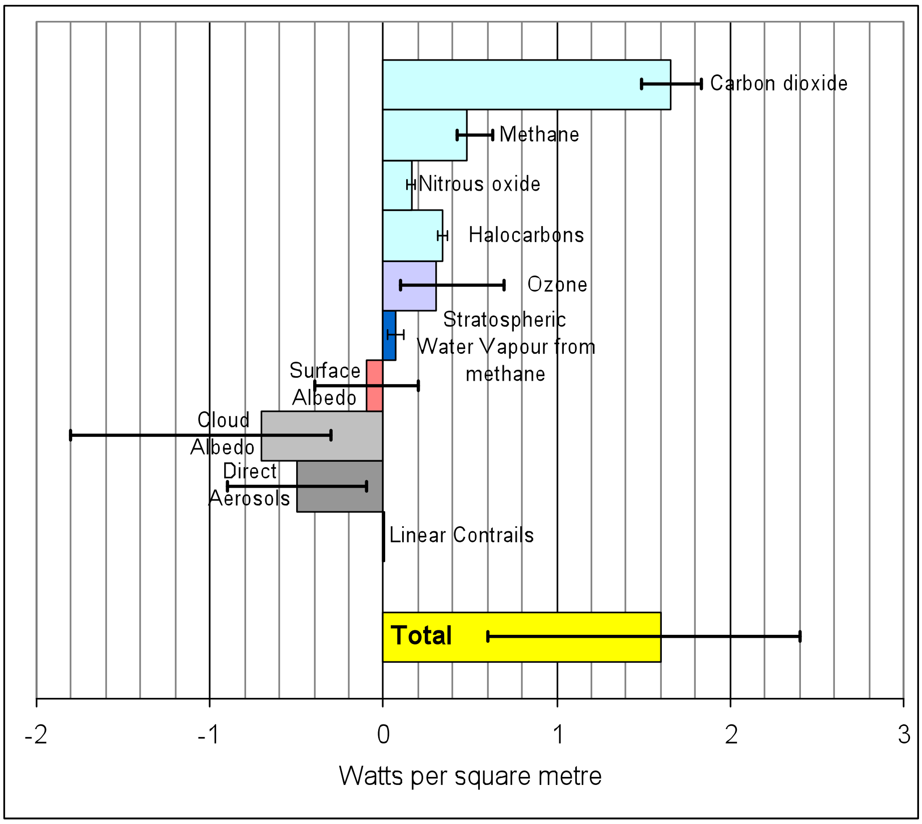


Figure 18: *Radiative forcing from various sources. The error bars show the uncertainty for each source. The total is described by the IPCC as "the global average net effect of human activities since 1750 has been one of warming, with a radiative forcing of +1.6 [+0.6 to +2.4] W m^{-2} (see Figure SPM.2)". [IPCC-AR4 2007 WG1 Fig SPM.2]. Note the large uncertainties for aerosol and albedo forcing.*

The figure shows that the IPCC derived estimate of radiative forcing is 1.6 Watts per square metre from a range of sources which in many cases have considerable errors. Some are estimates based on "expert" opinion not measurement. These large errors give the summed total radiative forcing itself an equally large error. The radiative forcing value, in turn, leads the IPCC to claim in its last report that the resulting temperature increase of 0.8 (+0.4 to +1.1)^{0}C explains the temperature increase since 1750.

The temperature effects of the components of radiative forcing are often presented as feedback. It is generally agreed that there is a temperature increase due to increasing CO_2 and other greenhouse gases. Feedback is the result of other radiative forcing components that increase or decrease this temperature change. The feedback is represented by the formula: $$\Delta T = \Delta T_0 / (1-f)$$
where ΔT_0 is the initial calculated temperature increase, f the feedback factor and ΔT is the final temperature increase.

Table 4: Feedback and temperature increase when atmospheric CO2 doubled

	f feedback	ΔT ^{0}C
Negative feedback (not found in any climate models but calculated by others)	-1.4 to -0.2	0.5 to 1.0
No feedback – ΔT_0 baseline from CO_2 and other greenhouse gases	0	1.2
Positive feedback (found in all climate models)	0.4 to 0.7	2.0 to 4.5
Measurement (this example is from precipitation)	**-0.5**	**0.8**