

**Senate Standing Committee on Environment, Communications and the Arts  
Legislation Committee**

Answers to questions on notice

**Environment, Water, Heritage and the Arts portfolio**

Additional Estimates, February 2010

<b>Outcome:</b>	1	<b>Question No:</b>	19
<b>Program:</b>	1.1		
<b>Division/Agency:</b>	Bureau of Meteorology		
<b>Topic:</b>	Weather stations – Darwin Airport		
<b>Hansard Page ECA:</b>	17 (9/2/10)		

**Senator ABETZ asked:**

**Senator ABETZ**—(a) Can you tell us then how many of those automated weather stations are around Darwin airport, because I have been told that we have (b) five different records covering Darwin from 1941? Take it on notice; I do not need the answer now, and I do not want to delay.

**Dr Ayers**—I believe I can give you the detail you seek.

**Senator ABETZ**—Thank you.

**Dr Ayers**—The records in Darwin have changed because there have been shifts in the location of the weather station during the period since 1940. The reference to multiple records is to one record for the airport but at different locations within the airport vicinity.

**Senator ABETZ**—But whilst they have been shifted, all of the automated stations agree almost exactly, is that right?

**Dr Ayers**—The earliest part of the record would not have been an automated station.

**Senator ABETZ**—What about from 1941 onwards?

**Dr Ayers**—I believe they would not have been automated weather stations.

**Senator ABETZ** – (c) Can you tell us when they were first automated, on notice?

**Dr Ayers**—We do have that information, and I can give you that on notice.

**Senator ABETZ**— (d) If you can take that on notice, also whether the information out of the various weather stations or automated stations are indicating very similar temperatures as well?

**Dr Ayers**—I just make the single point that, when stations are moved, there will be inevitably some change in temperature. The bureau has procedures as it does so to compare the changes and to track the changes. I do not have the detail on how that was done in that period, but there will be such information.

**Senator ABETZ**—If you could give me some information on that, whatever is to hand. Do not bother undertaking a major research project on that. In relation to the climate change debate, a certain number of assertions have been made about Darwin and I am just interested in getting your information.

**Answers:**

- (a) There are 11 stations currently operating in the Darwin area that measure daily maximum and minimum temperature. Nine of these stations are automatic, and most of them commenced operation within the last twenty years.

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- (b) Pre 1941, the temperature data for Darwin were recorded at the Darwin Post Office. Observations ceased at the Post Office in February 1942 when it was destroyed during the air raids. Observations at Darwin Airport commenced in February 1941. Because of changes to the airport, the Darwin Airport observation site has also moved several times (five times between 1963 and 1990) within the airport precinct.

Darwin Airport is the primary station used to record maximum and minimum temperatures for the Darwin region, including those 'official' figures attributed to the Bureau of Meteorology in the media.

To obtain a homogeneous Darwin temperature data set, adjustments are made to the historical data to make them comparable with the present-day site and instruments. These adjustments include a  $-0.8^{\circ}\text{C}$  to account for the move from the Post Office (a move from a coastal site to a more inland site) and smaller adjustments totally  $-0.6^{\circ}\text{C}$  to account for movements within the airport grounds. Adjustments are made based on a comparison of data for an overlapping period, or with a continuous neighbour station.

- (c) The Darwin Airport station opened in February 1941 and an automatic weather station was installed there in October 1990.
- (d) The temperature reports from the various weather stations are generally very similar, except for differences readily attributable to topographic and seasonal variations. For example, temperatures tend to be cooler at sites closer to the coast during the day during summer and warmer at the same sites during winter at night. Because of these influences, the Darwin temperature data is not currently used in calculation of the annual Australian temperature and associated graph in the Annual Climate Statement.

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<b>Outcome:</b>	1	<b>Question No:</b>	20
<b>Program:</b>	1.1		
<b>Division/Agency:</b>	Bureau of Meteorology		
<b>Topic:</b>	BOM website hits		
<b>Hansard Page ECA:</b>	18 (9/2/10)		

**Senator LUNDY asked:**

**Senator LUNDY**—I had heard that, so it is great to get the real numbers on the record.

**Dr Ayers**—It is an important area for us, that we will continue to work on. I may not have remembered the second part of the question.

**Senator LUNDY**—I will just keep asking you questions about it. You mentioned that it (web hits) had grown by 20 per cent per annum?

**Dr Ayers**—Roughly; something of that order.

**Senator LUNDY**— (a) How consistent has that been?

**Dr Ayers**—I will refer you back to the figure in the annual report.

**Senator LUNDY**—I am happy for you to take it on notice.

**Dr Ayers**—It goes back about 15 or 20 years.

**Answer:**

(a) The growth in use of the website is shown in the table below by the annual percentage increase in hits.

Year	Total number of hits (million)	Increase in hits Since previous year (million)	Percentage increase in hits since previous year
1997	23.92		
1998	62.25	38.33	160.24
1999	116.35	54.1	86.91
2000	192.23	75.88	65.22
2001	729.01	536.78	279.24
2002	1383.37	654.36	89.76
2003	2817.9	1434.53	103.70
2004	5682.4	2864.5	101.65
2005	9344.07	3661.67	64.44
2006	9918.72	574.65	6.15
2007	17181.38	7262.66	73.22
2008	19310.09	2128.71	12.39
2009	21735.35	2425.26	12.56

Note: The demand on the Bureau's website (as measured by hits) is highly dependent on the occurrence of significant meteorological and hydrological events such as tropical cyclones and floods. In the early years of the site's existence, in particular, it was also highly dependent on the level of public access to the internet.

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**Outcome:** 1 **Question No:** 21  
**Program:** 1.1  
**Division/Agency:** Bureau of Meteorology  
**Topic:** BOM staffing  
**Hansard Page ECA:** 19 (9/2/10)

**Senator IAN MACDONALD asked:**

**Senator IAN MACDONALD**—Just going back to where we were, with the centralisation of staff, could you indicate to me, on notice obviously, staff numbers in the capital cities say three years ago and what they are today, and staff numbers in the rest of Australia three years ago and what they are today? Could I get you to do that on notice?

**Dr Ayers**—Yes, we can take that on notice.

**Answers:**

Staff located in capital cities:

As at:	Melbourne	Perth	Adelaide	Darwin	Brisbane	Sydney	Canberra	Hobart
30 June 2007	800	87	79	67	92	99	9	58
22 February 2010	859	89	75	60	92	136	53*	61

Staff located outside capital cities:

As at:	Victoria	Western Australia	South Australia	Northern Territory	Queensland	New South Wales / ACT	Tasmania/ Antarctica
30 June 2007	11	35	12	12	55	23	18
22 February 2010	9	35	10	10	55	20	22

Total staff numbers:

As at	Capital Cities	Regional	<b>Total</b>
30 June 2007	1291	166	<b>1457</b>
22 February 2010	1425	161	<b>1586</b>

\*The large increase in Canberra staff is primarily due to additional staff being located in Canberra resulting from the Bureau responsibilities under the *Water Act 2007*.

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<b>Outcome:</b>	1	<b>Question No:</b>	22
<b>Program:</b>	1.1		
<b>Division/Agency:</b>	Bureau of Meteorology		
<b>Topic:</b>	Copenhagen climate change conference		
<b>Hansard Page ECA:</b>	20 (9/2/10)		

**Senator IAN MACDONALD asked:**

**Senator IAN MACDONALD**—Will there be, at some time, a public report that I can read that says (a) what your guy did there, (b) what his purpose was and (c) what he got out of it? (d) Does he report to you?

**Dr Ayers**—I am happy to take that on notice.

**Senator IAN MACDONALD**—Okay. I am just interested to know what his purpose was. (e) Can you also tell us the cost of sending your representative there? (f) Was that paid by you or by the department of the Prime Minister?

**Dr Ayers**—We will take that on notice.

**Answers:**

- (a) In line with our historical involvement in, and commitment to, United Nations Framework Convention on Climate Change (UNFCCC) meetings, a Bureau of Meteorology representative attended the Fifteenth Conference of the Parties (COP15) and the Thirty-first session of the Subsidiary Body for Scientific and Technological Advice (SBSTA31) to the UNFCCC in Copenhagen, 7 - 18 December, 2009.

The primary purpose for attending was to represent Australia at the SBSTA31 under the Research and Systematic Observations agenda item. Issues discussed included:

- Following the culmination of much effort (including submissions from Parties – Australia provided a substantial report on the state of its Systematic Observations) the Global Climate Observing System (GCOS) Secretariat provided its draft updated Implementation Plan. The document provides the roadmap for how to address deficiencies in global systematic observations including estimates of the cost and viability of achievement.
- The World Meteorological Organization (WMO) Deputy Secretary-General reported on the significant outcomes of the World Climate Conference–3 of which the primary goal is to develop over the next decades a Global Framework for Climate Services.
- A draft decision was compiled to be forwarded to the COP discussing the two major milestones as well as other reports from the Global Terrestrial Observation Secretariat and the Committee on Earth Observation Satellites. The decision was

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drafted to highlight some key outcomes from the GCOS report for instance explicitly stating that *“limited advances have been made in achieving long-term continuity for several in situ observing systems and that there are still large areas, in Africa for example, for which in situ observations and measurements are not available”*;

- (b) The purpose in the attendance of the Bureau of Meteorology representative at SBSTA31 and COP15 was to ensure that Australia’s interests in negotiations on agenda items that addressed Research and Systematic Observations (including Intergovernmental Panel on Climate Change (IPCC) related material) were taken into consideration and that other members of the Australian delegation had access to Australian climate information and science knowledge (and related advice) in discussion of other Conference items relating to adaptation.
- (c) The Bureau of Meteorology representative was able to both learn from other national representatives and also input Australian experiences into discussions primarily related to climate information and science. The Bureau representative represented Australia’s interests and provided Australian climate information to discussions at Conference sessions including:
- the WMO release of their preliminary assessment of the climate for the year 2009. Knowledge on the global climate for 2009, in the context of global climate trends, was obtained and input was provided on aspects of Australia’s climate during 2009;
  - an IPCC discussion on the potential impacts from the email hacking episode at the Climate Research Unit in East Anglia, UK led by Dr Rajendra Pachauri, Chair of the IPCC. The meeting focussed on the implications for the IPCC 4<sup>th</sup> and 5<sup>th</sup> assessment reports. An understanding and appreciation for how other groups are handling the issues that have arisen was obtained;
  - the SBSTA31 under the Research and Systematic Observations agenda item. Systematic observations are the foundation of climate change science and the Bureau representative learnt how other National Meteorological Services are responding to pressures on observation systems in terms of new technology and ongoing maintenance and adherence to standards; and
  - many additional negotiation sessions under other agenda items in order to provide scientific assistance to other delegation members; in particular, the Ad Hoc group on Long Term Cooperative Action. The Bureau representative increased their understanding of the importance of the climate observation and information to the current climate change debate and also the importance of presenting climate information in a clear and concise manner.

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- (d) During COP15, the Bureau of Meteorology representative is part of the Australian delegation and therefore answers to the head of delegation. The representative also provided a link back to the Bureau through correspondence with the Climate and Oceans Branch of the Bureau. Under normal working arrangements, the person involved is a Bureau employee and is therefore ultimately in line management to the Director of Meteorology through the normal management structure. On completion of the mission, a summary overseas visit report is prepared for the Director of Meteorology.
- (e) Approximately \$21,000 (acquittal yet to be finalised).
- (f) The Bureau of Meteorology.

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<b>Program:</b>	1.1		
<b>Division/Agency:</b>	Bureau of Meteorology		
<b>Topic:</b>	Sunday Telegraph article – Cardinal Pell		
<b>Hansard Page ECA:</b>	20 (9/2/10)		

**Senator IAN MACDONALD asked:**

**Senator IAN MACDONALD**—I do not want to carry this on too far, but could I ask you to refer to an article about emissions by Cardinal Pell in Sunday's edition of the *Sydney Sunday Telegraph*. In that article, he had some opinions of his own, but he also made a number of factual statements. I wonder if you would mind assisting the Senate by going through that article and indicating—in relation to facts, not arguments or opinions—whether Cardinal Pell is right. For example, he has gone back over 20,000 years talking about the number of El Nino impacts and those sorts of things. Would you mind, with your expertise, just having a look at that? As I say, do not take issue with his arguments—I would not expect you to do that—but could you let me know, from a bureau point of view, whether the things he presented as facts were accurate or inaccurate? He talks about La Nina, El Nino and things like that, which made a lot of sense to me, but I would like to get your view on it.

**Answers:**

Reponses to the scientific statements presented in Cardinal Pell's article about climate change in the *Sydney Sunday Telegraph* are laid out below.

**1. El Niño ... brings us droughts ... and La Niña brings us rain.**

It is the case that many historical El Niño events have brought drought, and many historical La Niña events have brought above average rainfall to Australia, and particularly eastern Australia. However, each event is unique in intensity, duration, extent and impact. In addition, the El Niño/La Niña influence on rainfall changes over time and through the seasons and is moderated by other climate drivers such as the Indian Ocean Dipole. For example, the 2007-08 La Niña resulted in high rainfalls in northern Australia, but did not bring significant rainfalls to the south-eastern parts of the country.

**2. We can now chart the history of El Niño for 20,000 years and the records show La Niña has been absent for a 15-year period at least once.**

The best historic reconstructions of El Niño-Southern Oscillation (ENSO) variability, using a range of climate indicators (including in sediments, ice-cores, coral reefs and trees) extend



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back approximately 400 years. Researchers have found it difficult to accurately produce a reliable record of discrete El Niño and La Niña events from these reconstructions. This makes it difficult to determine whether a La Niña event has been absent for a 15 year period at least once in the last 400 years with a high degree of confidence. Attempts made to produce reconstructions that go back 20,000 years are possible, but highly uncertain.

**3. The present drought, which may be ending, has lasted for nine years.**

The present drought has lasted for nine years in many parts of southeast Australia (including the Murray-Darling Basin), and longer in southern coastal areas. In much of Victoria and adjacent areas of South Australia and Tasmania the drought commenced in late 1996 and appears to be continuing. The far southwest of Australia has experienced a 40-year rainfall decline which is also continuing.

River flows and rainfall totals were well below average in 2009 across the main drought affected areas including the southern Murray-Darling Basin, southwest Western Australia and Victoria. Even though there has been heavy rainfall in recent weeks, particularly in Queensland and northern New South Wales, it will take many years of sustained rainfall to alleviate the accumulated rainfall deficiencies in Australia's drought affected regions.

**4. There has been drought somewhere on the continent for 48 of the past 144 years.**

Depending on how one has defined drought this may be a factually correct statement. Drought is certainly a pervasive feature of the Australian climate with major droughts occurring in most decades.

**5. Global warmers claim human activity, especially industry, is increasing the level of carbon dioxide in the atmosphere, causing warming.**

Direct measurements of atmospheric carbon dioxide (CO<sub>2</sub>) concentrations show that the level of CO<sub>2</sub> in the atmosphere and oceans has increased. Isotopic analysis of this CO<sub>2</sub> shows that most of the increase is due to the burning of fossil fuels. Isotopic analysis is a very precise technique for identifying the source of carbon in the environment which can then be compared back to total fossil fuel use. Other greenhouse gases have also increased including methane and chlorofluorocarbons.

The link between CO<sub>2</sub> increase and warming is established through both climate model simulations of the climate system and paleoclimatic and historical reconstructions of the Earth's temperature. For example, there is a tight coupling between temperature and CO<sub>2</sub> on timescales from a few decades to millions of years.

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**6. Carbon dioxide is only a trace gas ... makes up less than four parts in 10,000.**

CO<sub>2</sub> is a trace gas. However it is also one of the main greenhouse gases, along with water vapour, methane, nitrous oxide and ozone which are responsible for the natural greenhouse effect that maintains the temperature of the Earth's surface some 33°C warmer than it would otherwise be. Since the start of the industrial revolution human activity has increased the concentration of CO<sub>2</sub> by around 38%, from 300ppm to 386ppm in 2009. It is very likely that this increase, along with increases in other anthropogenic greenhouse gases (principally methane and nitrous oxide) is responsible for most of the warming observed since the mid 20<sup>th</sup> century.

**7. ... temperatures were higher in Roman times and in the Middle Ages (900-1300 AD) - when there was no industry and fewer people than there are today**

All available hemispheric to global scale analyses published in the peer reviewed literature suggest that recent decades have been warmer than those of the Middle Ages. There are no global scale analyses currently available to provide a basis for comments about the temperatures during Roman times.

**8. ...that for most of history the amount of carbon dioxide has been higher than it is today**

Over the past 800,000 years, the amount of CO<sub>2</sub> in the atmosphere has varied naturally between approximately 172 and 300 parts per million (ppm) as a result of natural processes. In 2009 the level was 386ppm, around 38% higher than in 1750. The global increase in CO<sub>2</sub> concentration is primarily due to the burning of fossil fuels and land use change.

Over geological time, prior to human civilisation, there is evidence which suggests that until approximately 350 million years ago high concentrations of CO<sub>2</sub> dominated the planet's atmosphere. While the records are less than perfect, there is evidence that from 400 to 600 million years ago atmospheric CO<sub>2</sub> levels were 10 to 20 times current levels.

**9. ...and that an increase in carbon dioxide follows rises in temperature**

In geological history, temperature variations have both led and lagged changes in CO<sub>2</sub>. For the glacial/interglacial (ice age) transitions of the recent geological past, the evidence suggests that it is changes in the Earth's orbital parameters and associated solar variations which triggered the initial temperature changes. These changes were then amplified by the CO<sub>2</sub>-temperature feedback (a warmer climate releases more CO<sub>2</sub> into the atmosphere which causes further warming) and the ice-albedo feedback (a warmer climate has less ice which reduces reflected sunshine and leads to more warming). This feedback mechanism between the Earth's temperature and CO<sub>2</sub> concentrations in the geological record provides evidence that CO<sub>2</sub> is a major driver of climate change.

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**10. Warming doesn't bring less rain.**

Over the globe as a whole, model projections of the climate indicate that rainfall will increase in a warming world (as will evaporation), but that the increases will mainly be in the tropics and high latitudes (such as the Arctic/Antarctic) with decreases likely in the subtropics, including Australia. The general pattern of change is that wet areas become wetter and dry areas become drier. It is difficult to precisely predict what climate change will mean at specific, individual locations of the globe.

**11. Certainly, Australia's base there, visited by the Catholic chaplains, originally at the water's edge, is now 21km from the sea because of expanding pack ice.**

Sea ice around Antarctica varies from about 20 million km<sup>2</sup> in September to about 3 million km<sup>2</sup> at the end of the summer. Australia has three permanent observing stations in the Antarctic - Casey, Davis and Mawson - which are usually ice bound in winter but often free of sea ice in summer. There is a mixed picture of increases and decreases in sea ice. For example, the western Antarctic Peninsula region has shown a decline in sea ice extent, whereas sea ice in East Antarctica is showing a small increase. The increase in sea-ice around East Antarctica has been attributed to increased wind speeds around Antarctica linked to increased storms.

**12. Britain, China and Russia have just experienced their most bitter winter for decades.**

The northern winter of 2009-10 has been characterised by large geographic variations in temperature and rainfall/snowfall with unusually mild conditions in northern Africa, southern Europe, the Arctic and Canada, and unusually cool conditions occurring in northern Europe, Russia and China. Globally January 2010 was the fourth warmest month on record based on land and ocean average surface temperature measurements. According to satellite data, the winter period in the Northern Hemisphere (December to February inclusive) was much warmer than average with preliminary data suggesting it was the warmest winter on record.

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<b>Outcome:</b>	1	<b>Question No:</b>	24
<b>Program:</b>	1.1		
<b>Division/Agency:</b>	Bureau of Meteorology		
<b>Topic:</b>	Water surface temperature – Great Barrier Reef		
<b>Hansard Page ECA:</b>	21 (9/2/10)		

**Senator IAN MACDONALD asked:**

**Senator IAN MACDONALD**—Again, we went through this a year or two year ago, but I wonder if we could have the update for this year on water temperature, perhaps on notice.

**Answer:**

Figure 1 shows a graph of the annual average sea surface temperature anomaly for the tropical parts of Australia (approx. 90<sup>0</sup>E – 170<sup>0</sup>E / Equator – 20<sup>0</sup>S) including the Gulf of Carpentaria. The measurements are satellite based, calibrated by in situ observations from ships and drifting buoys.

The average sea surface temperature for the tropical parts of Australia for 2009 was +0.47<sup>0</sup>C above the longer term average temperature. It was the third highest anomalous sea surface temperature since 1900. Monthly anomalies in 2009 ranged from +0.25<sup>0</sup>C (Feb/Mar) to +0.7<sup>0</sup>C (July). In comparison, the average annual anomaly in 2008 was +0.28<sup>0</sup>C.

The overall, longer term trend and year-to-year variations continue to show increasing temperatures above the average for sea surface temperatures. Whilst there has been less of a trend over the past 8-10 years, the sea surface temperatures still remain significantly warmer than the average.

Annual variations in sea surface temperature can occur due to El Niño and La Niño events, due to changes in ocean circulation and surface heating. Ocean currents may bring warmer or cooler waters into the region. Extended periods of low wind conditions can lead to warmer sea surface temperatures, due to reduced mixing of warmed surface waters with colder subsurface waters. Similarly, tropical cyclones gain energy by extracting heat from the ocean's surface waters.

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**ANNUAL SEA SURFACE TEMPERATURE ANOMALY – NORTHERN TROPICS**

10-year running averages are shown by the black curve

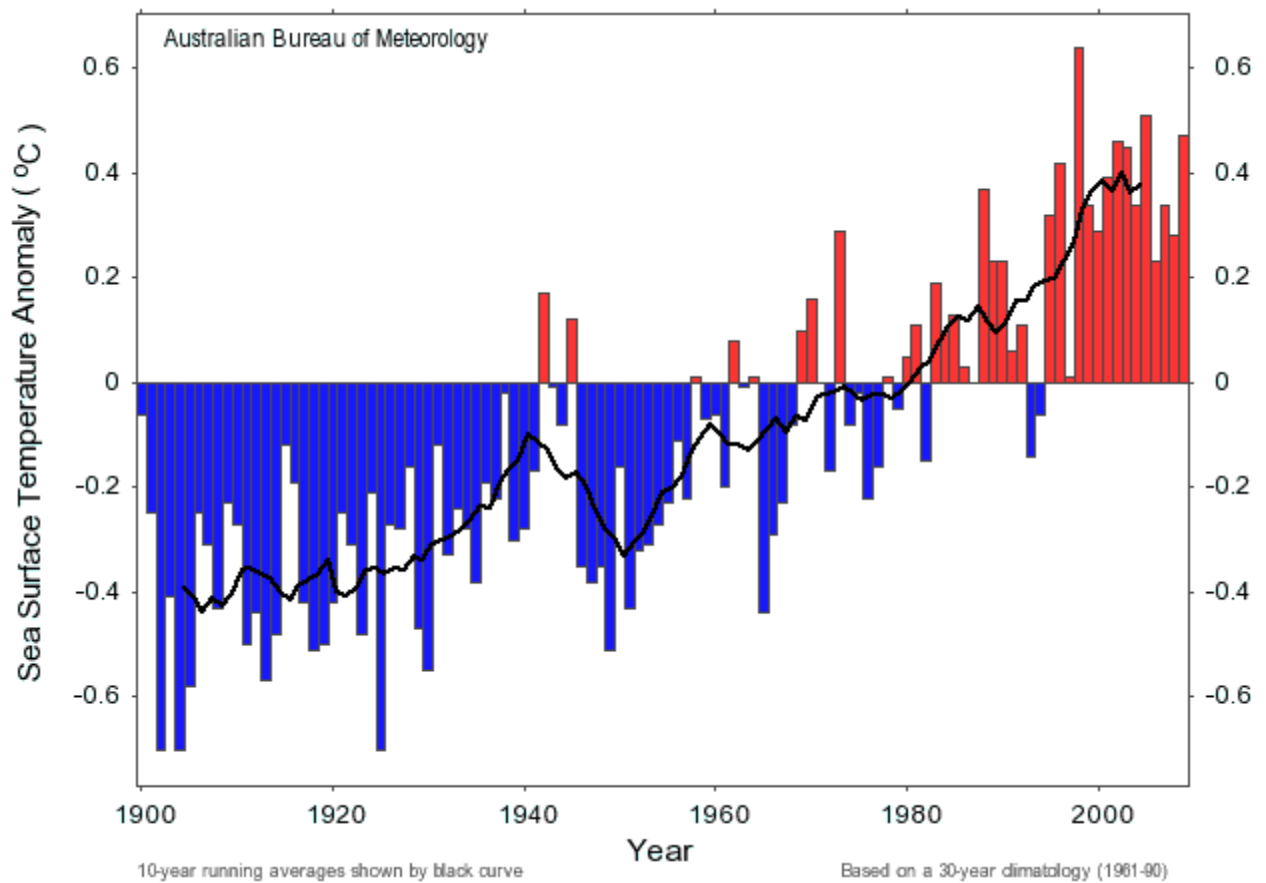


Figure 1: Average sea surface temperature anomalies around tropical Australia for 1900 through 2009.