

Modelling Australian and Global Temperatures: What's Wrong? Bourke and Amberley as Case Studies

Jennifer Marohasy, John Abbot, Ken Stewart and Dennis Jensen,

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On 3rd January this year, David Jones, Manager of Climate Monitoring and Predictions at the Australian Bureau of Meteorology said on ABC radio that: “We know every place across Australia is getting hotter, and very similarly almost every place on this planet. So, you know, we know it is getting hotter and we know it will continue to get hotter. It’s a reality, and something we will be living with for the rest of this century.”

That morning the Bureau of Meteorology had put out a media release headed “hottest year on record” explaining that in 2013 the average annual temperature for Australia was 1.20 degree C above the long-term average of 21.8 degree C, breaking the previous record set in 2005 by 0.17 degree C. Such reference to changes in fractions of a degree suggests the Bureau has very accurate temperature records.

This paper considers the records for Bourke and Amberley and the methodology employed by the Bureau in compiling the annual statistics from such temperature series. We will also consider how NASA’s Goddard Institute for Space Studies (GISS) homogenizes data from Amberley in the development of its annual global mean temperature. Homogenization refers to a process of changing the actual temperature records using mathematical algorithms.

There are 112 weather stations that make up the official Australian series, which is the Australian Climate Observation Reference Network – Surface Air Temperatures with the acronym ACORN-SAT. Bourke and Amberley are part of this series and were chosen as case studies, because people tend to know where they are – Bourke made

famous by Henry Lawson and Amberley being the largest RAAF base in Australia. Also Amberley and Bourke provide something of a contrast with each other: Amberley is a relatively new recording site opened only in 1941, while Bourke was one of the first established in 1871; Amberley is east of the Great Dividing Range while Bourke is in the outback; at Amberley the weather recording equipment has always been within the perimeter of a military installation while at Bourke, for 125 years, temperatures were recorded at the local post office.

Yearbooks once published by the Bureau credited Bourke with the highest accepted shade temperature record in Australia at 127 degrees Fahrenheit (52.8 degree Celsius) on 16 January 1877 and after installation of the Stevenson screen in 1908, which is the universally accepted cover for recording shade temperatures, the highest Australian temperature reading is 125 degrees Fahrenheit recorded at Bourke on 3 January 1909.

These are the temperatures that were recorded in the 'Meteorological Observation' books once kept at the Bourke post office. While these recorded temperatures may not have been broken, they have since been scratched. Indeed they are no longer included in the official statistics, including the statistic that declared last year to have been the hottest year on record.

Which brings us to a key question: how do we know it's getting hotter and that 2013 was the hottest year on record? Some might want to shout: Because Dr David Jones from the Australian Bureau of Meteorology told us so on ABC radio in January. But our question is more specific. How was this statistic calculated?

The Bureau begins with real temperature data. This data is first truncated with all records before 1910 deleted, then some of the individual remaining record hot days are scratched or substituted, before temperature series are submitted to a two-step homogenization process involving the application of mathematical algorithms, before

most of the new series for each of the ACORN-SAT locations are combined based on an area weighting.

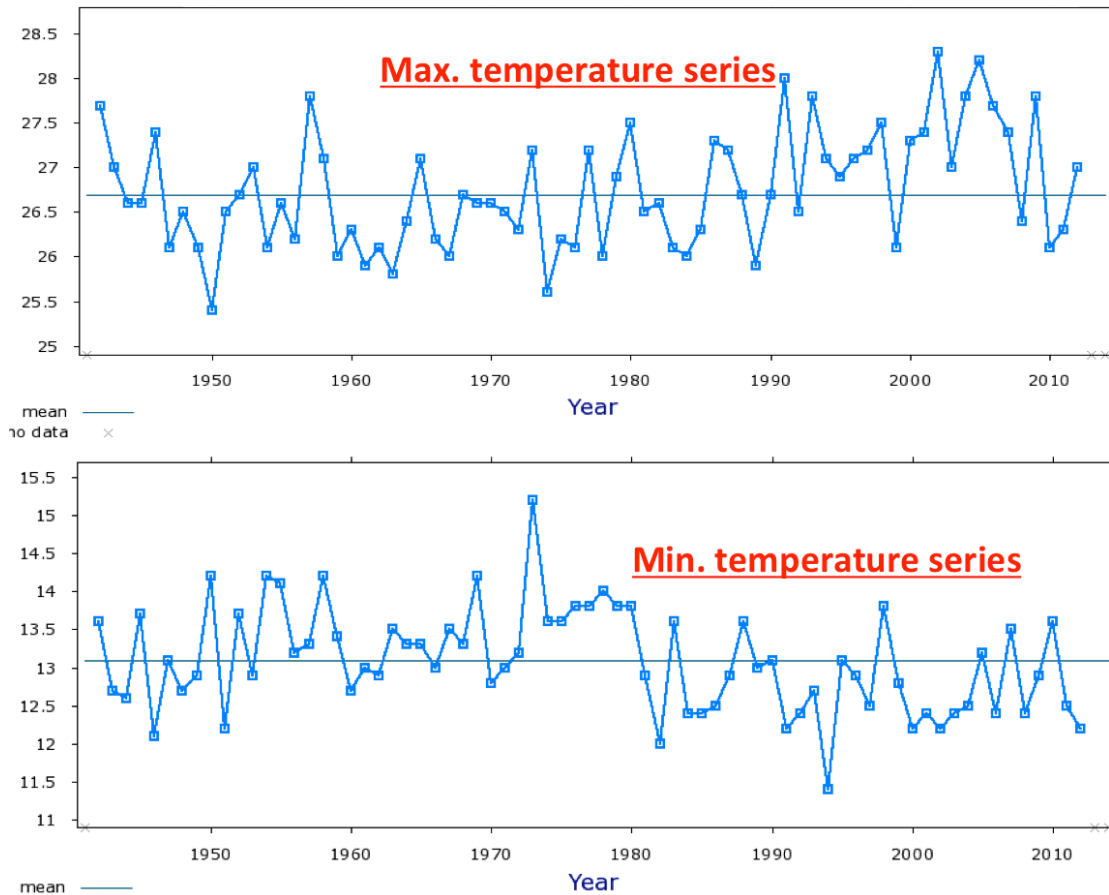
At the Bureau's website it states that, "ACORN-SAT reaffirms the trends previously identified by the Bureau of Meteorology. The new data shows that Australia has warmed by approximately 1 degree C since 1910. The warming has mostly occurred since 1950. The warming in Australian temperature data is very similar to that shown in international data..."

So, homogenized data from the 112 ACORN-SAT sites is "new data". Dr Dennis Jensen MP, recently visited the Bureau's headquarters in Melbourne asking specific questions about how this "new data" was generated. He was assured that the new homogenised series are better; better than the data as originally recorded.

While anthropogenic global warming (AGW) may be the greatest moral issue of our time, it really should be based on evidence, not make-believe. Aynsley Kellow, Professor and Head of the School of Government at the University of Tasmania, has explained that, since the advent of computer modeling, it is very important to make a distinction between output from a computer model and real data. In his book *Science and Public Policy: The virtuous corruption of virtual environmental science* he shows through many examples, including from climate science, how a reliance on computer models over the last 30 years as well as the infusion of values, has produced a preference for virtual over observational data.

Let's have a look at some of the real observational data (the unhomogenized data) and also the homogenized temperature series. The temperatures series we refer to in this paper, are from numbers that have been downloaded from the Bureau's website.

Fig. 1. Amberley 1941 to 2013



The unhomogenized mean annual maximum temperatures for Amberley since recordings were first made in 1941 show temperatures trending up from a low of about 25.5 degree C in 1950 to a peak of almost 28.5 in 2002, Figure 1. Last year, 2013, was not the hottest year on record, Figure 1.

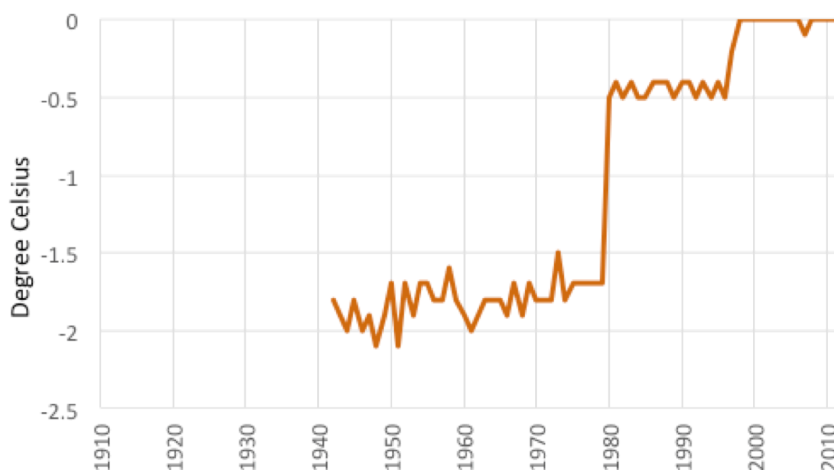
The minimum temperature series for Amberley shows cooling from about 1970, Figure 1.

Of course this does not accord with anthropogenic global warming theory. To quote Karl Braganza from the Bureau as recently published by online magazine *TheConversation*, "Patterns of temperature change that are uniquely associated with the enhanced greenhouse effect, and which have been observed in the real world include... Greater warming in winter compared with summer... Greater warming of night time temperatures than daytime temperatures".

The Bureau has “corrected” this inconvenient truth by jumping-up the minimum temperatures twice through the homogenization process: once around 1980 and then around 1996 to achieve a combined temperature increase of over 1.5 degree C, Figure 2. This is obviously a very large step-change, remembering that the entire temperature increase associated with global warming over the 20th century is generally considered to be in the order of 0.8 degree C.

According to various peer-reviewed papers, and technical reports, homogenization is a technique that enables non-climatic factors to be eliminated from temperature series. It is often done when there is a site change (for example from a post office to an airport), or equipment change (from a Glaisher Stand to a Stevenson screen). But at Amberley neither of these criteria can be applied. The temperatures have been recorded at the same well-maintained site within the perimeter of the air force base since 1941.

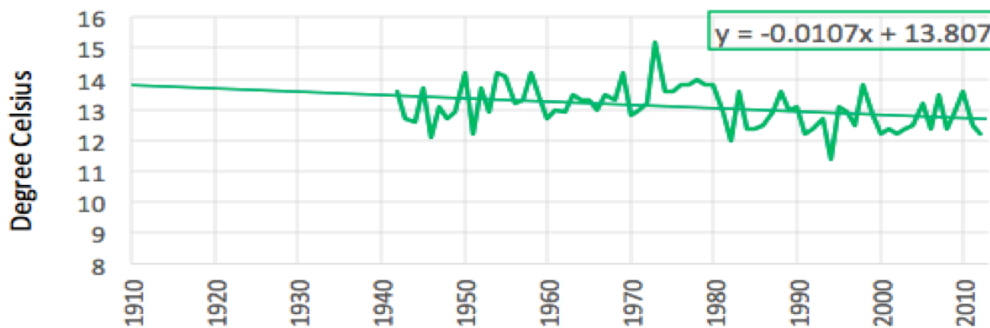
Fig. 2. Difference Between ACORN-SAT and Unhomogenized Annual Mean Minimum Temperature for Amberley 1941 to 2013



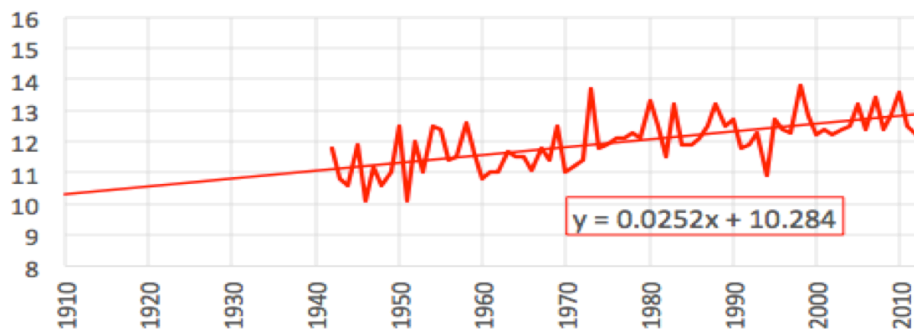
Through the homogenization process the Bureau have changed what was a cooling trend in the minimum temperature of 1.0 degree C per century, into a warming trend of 2.5 degree C per century, Figure 3. Homogenization has not resulted in some small

change to the data set, but rather a change in the temperature trend from one of cooling to dramatic warming.

Fig. 3. Amberley Minimum Temperature Series 1941 to 2013
Green is unhomogenized, cooling by 1 degree per century

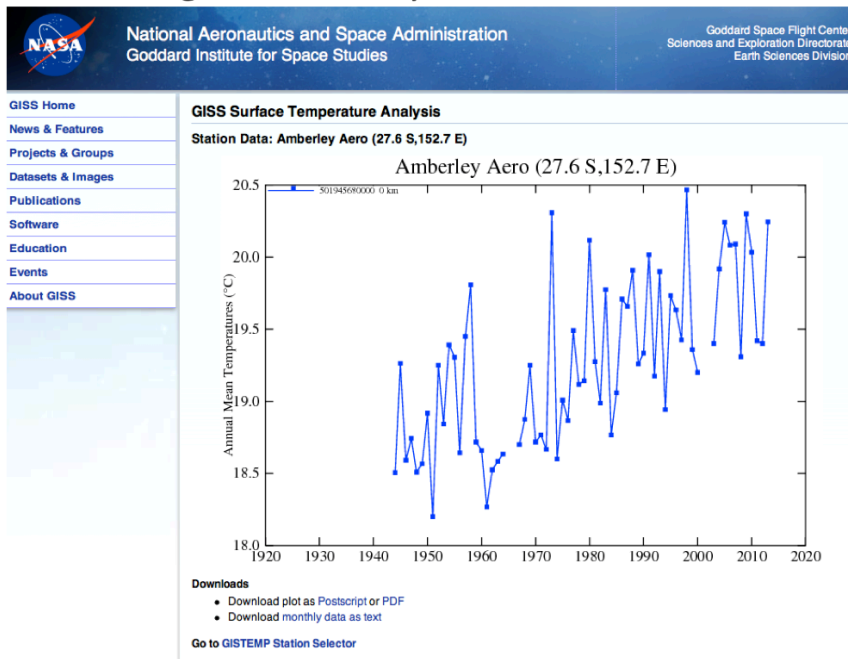


Red is the official record, warming by 2.5 degree per century



NASA's Goddard Institute for Space Studies based in New York also applies a jump-up to the Amberley series in 1980, and makes other changes, so that the annual average temperature for Amberley increases from 1941 to 2012 by about 2 degrees C, Figure 4. The new Director of GISS, Gavin Schmidt, recently discussed the issue with Jennifer Marohasy on Twitter with the entire conversation publicly available at @JennMarohasy.

Fig. 4. Mean Temperature Amberley After Homogenization by NASA's GISS



Dr Schmidt was quite blunt about what had been done to the Amberley minimum temperature series, “@jennmarohasy There is an inhomogeneity detected (~1980) and based on continuity w/nearby stations it is corrected. #notrocketscience”. When Dr Marohasy sought clarification regarding what was meant by “nearby” stations she was provided with a link to a list of 310 localities used by climate scientists at Berkeley when homogenizing the Amberley data. The inclusion of Berkeley scientists was perhaps to make the point that all the key institutions working on temperature series (the Australian Bureau, NASA, and also scientists at Berkeley) appreciated the need to adjust up the temperatures at Amberley.

But these 310 “nearby” stations, they stretch to a radius of 974 kilometres and include Frederick Reef in the Coral Sea, Quilpie post office and even Bourke post office.

Considering the unhomogenized data for the six nearest stations that are part of the Bureau’s ACORN-SAT network (old Brisbane aero, Cape Moreton Lighthouse, Gayndah post office, Bundaberg post office, Miles post office and Yamba pilot station)

the Bureau's jump-up for Amberley creates an increase for the official temperature trend of 0.75 degree C per century. Temperatures at old Brisbane aero, the closest station that is also part of the ACORN-SAT network, also shows a long-term cooling trend. Indeed perhaps the cooling at Amberley is real. Why not consider this, particularly in the absence of real physical evidence to the contrary?

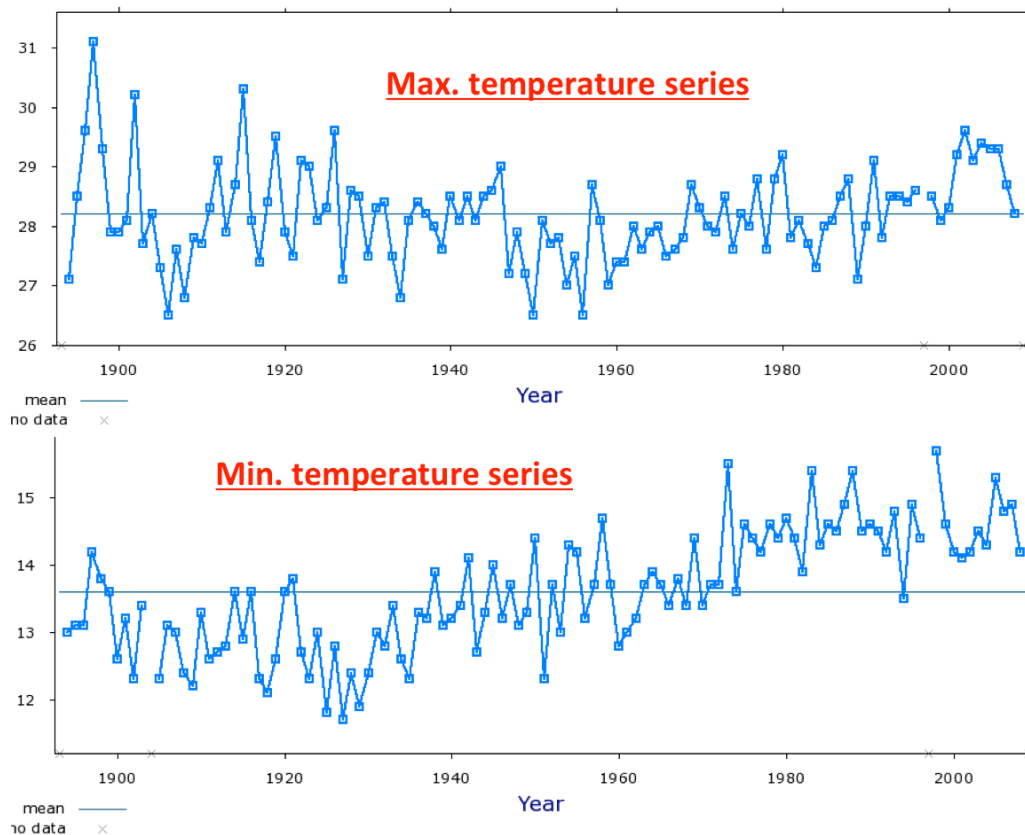
In the Twitter conversation with Dr Schmidt we suggested it was nonsense to use temperature data from radically different climatic zones to homogenize Amberley, and repeated our original question asking why it was necessary to change the original temperature record in the first place. Dr Schmidt replied, "@jennmarohasy Your question is ill-posed. No-one changed the trend directly. Instead procedures correct for a detected jump around ~1980."

If Twitter was around at the time George Orwell was writing the dystopian fiction *Nineteen Eighty-Four*, we wonder whether he might have borrowed some text from Dr Schmidt's tweets, particularly when words like, "procedures correct" refer to mathematical algorithms reaching out to "nearby" locations that are across the Coral Sea and beyond the Great Dividing Range to change what was a mild cooling trend, into dramatic warming, for an otherwise perfectly politically incorrect temperature series.

Before we move onto Bourke, let's first consider data from a "nearby" locality within a similar climatic zone to Amberley with an exceptionally long temperature record. Many of the temperature series for the locations Dr Schmidt linked to are incomplete, even including locations with records for just a few months in a few years. But Gayndah is somewhat unique having an almost complete temperature series that starts in 1893, continuing through until 2009, Figure 5.

Like most of the longer series, the maximum temperatures for Gayndah shows a lot of inherent variability. It's messy. It's not necessarily easy finding neat linear trends.

Fig. 5. Gayndah PO. 1893 to 2009



The Bureau often cautions against the use of earlier temperature series that predate the installation of a Stevenson screen. A Stevenson screen was installed at Gayndah in 1899. Maximum temperatures before this date could be up to one degree hotter than temperatures recorded in a Stevenson screen, but this makes little difference to the overall story for Gayndah. There were some hot years in the late 1800s and early 1900s.

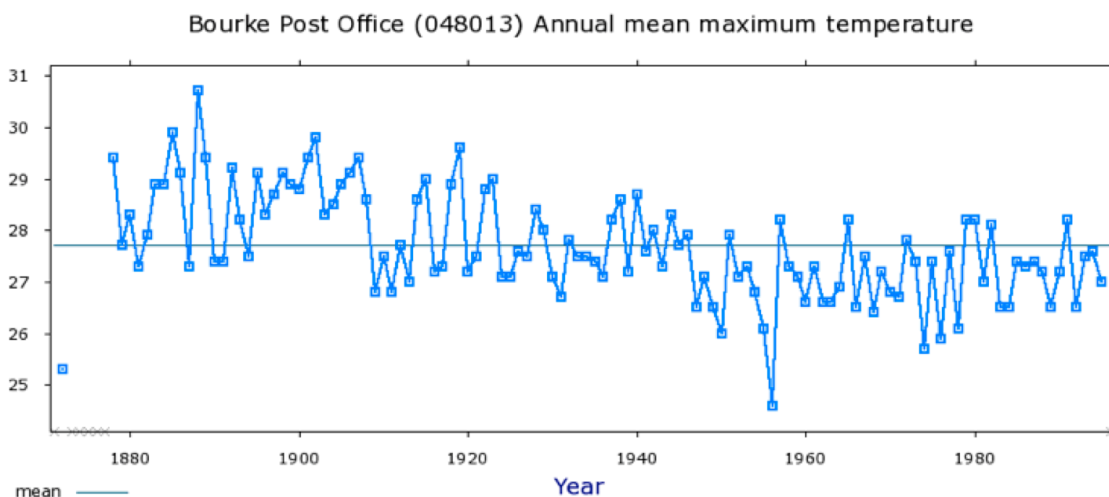
The minimum temperature series for Gayndah, Figure 5, shows consistent warming from about 1930 through to 2000. This does accord with both global warming theory and also an urban heat island (UHI) effect; that is higher temperatures associated with the build environment because asphalt retains heat and buildings block the wind. The temperature series for Sydney's Observatory Hill, for example,

shows a similar trend and this is attributed to the UHI and for this reason it is excluded by the Bureau in its calculation of the annual average mean for Australia.

It was also particularly hot at Bourke in the late 1800s and early 1900s, Figure 6. There is a cooling trend of 2.3 degree C per century to 1960. This data series ends in 1996; the year the weather station was moved to the airport.

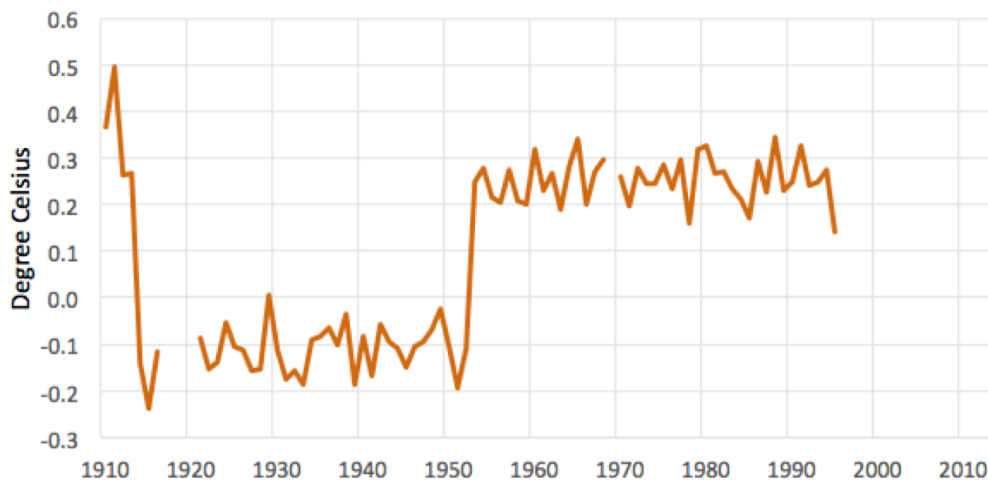
In the construction of the official temperature series for Bourke the worst thing that the Bureau has done is delete, yes delete, the first forty years of data. Temperatures before August 1908 were apparently not recorded in a Stevenson screen, but the Bureau could easily apply an algorithm to correct for this. If this data for Bourke, and for many other locations around Australia, were simply adjusted down by some fractions of a degree, it would be obvious that it was hotter in the early 20th century than for any period since.

Fig. 6. Maximum Temperature Bourke PO. 1871 to 1996



Instead the early record is deleted, and the post 1910 data homogenized. In particular, maximum temperatures are adjusted down between 1911 and 1915 by about 0.7 degree C and then up between 1951 and 1953 by about 0.45 degree C, Figure 7.

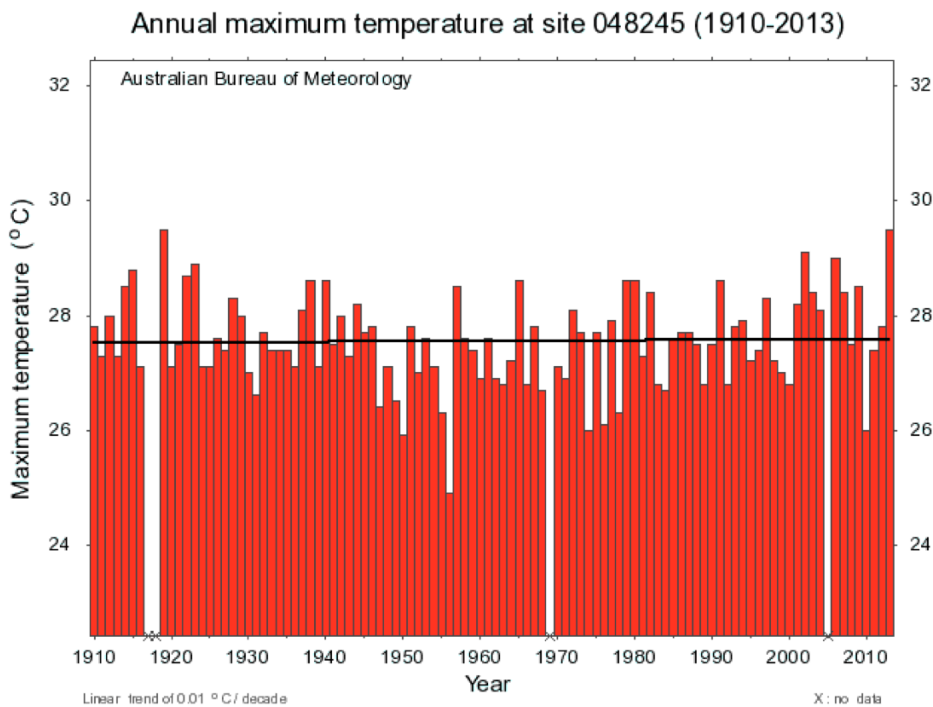
Fig. 7. Difference Between ACORN-SAT and Unhomogenized Annual Mean Maximum Temperature for Bourke 1910 to 2013



Dr Jensen asked for justification for these specific changes, the difference between the unhomogenized annual mean maximum temperatures for Bourke and the ACORN-SAT series, when he visited with Dr Jones in Melbourne. None were provided.

Rather than searching for a real physical explanation for the early 20th century cooling at Bourke, the Bureau has created a warming trend. This homogenization, and the addition of data recorded after 1996 from the airport, means that the official record shows an overall warming trend of 0.01 degree C per century, Figure 8. Furthermore, 2013 becomes about the hottest year on record for Bourke. Some might say, mission accomplished.

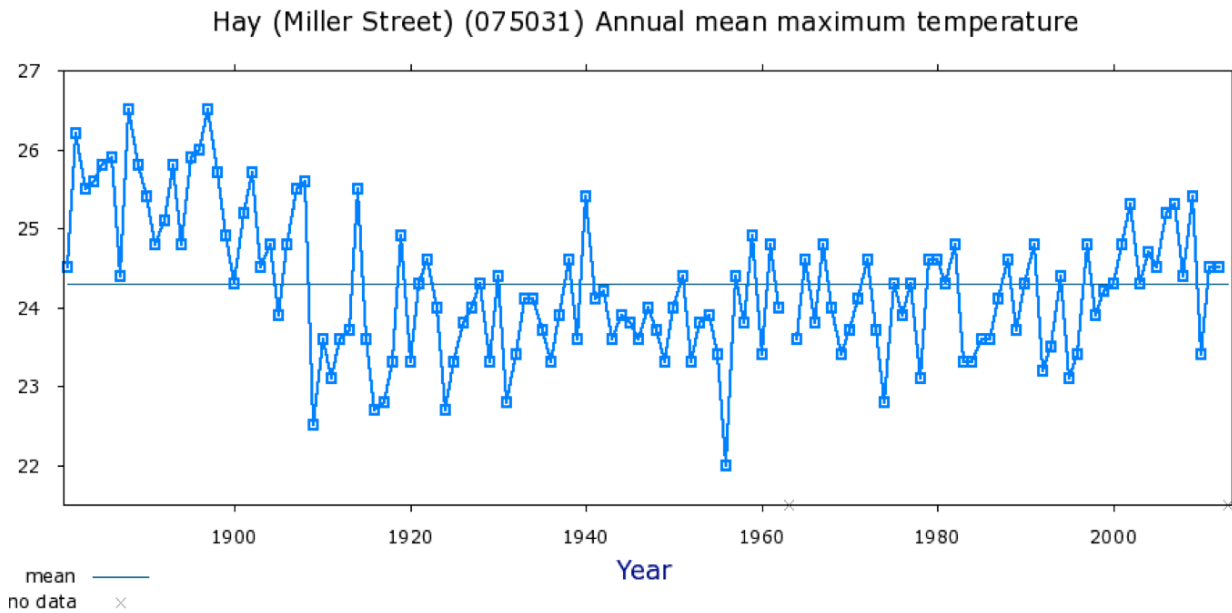
Fig. 8. Homogenized Maximum Temperature Bourke 1910 to 1913



Obviously gone are the hot days and years in the late 1800s. There is even a peer-reviewed paper that justifies the scratching of the record set on January 3, 1909 in the new Stevenson screen installed in August 1908. But to explain how this very hot day was reduced to a clerical error in the peer-reviewed climate science literature would require more words than we have for this paper, because we would have to work through temperature records for a long list of ‘nearby’ stations.

Let us instead briefly consider the maximum temperature series for Hay on the Murrumbidgee. It’s not an ACORN-SAT site, and we don’t know when a Stevenson screen was installed. We do know that the site has been moved within the town at least once, but retained the same number of Hay 75031. It was not moved to an airport. There is a continuous record from 1881 to 2013. This long record indicates it was very hot at the end of the 19th century, much hotter than last year, Figure 9. There was cooling to about 1960, then warming, Figure 9. The cooling trend is very similar to Bourke’s at -2.63 degree C per century for the period to 1960.

Fig. 9. Maximum Temperature Hay 1881 to 2012



If we arbitrarily designate 1960 as a turning point and consider most of the locations in New South Wales for which there are continuous maximum temperature series from before 1900 to 1960, and after 1960 to 2013, we find on average there was a cooling of -1.95 degree C per century until 1960, and a warming of 2.48 degree per century after 1960, Table 1.

Taking these values and thinking about them in terms of a rate of cooling for approximately 70 years (1890 to 1960) and then a rate of warming for 54 year (1960 to 2013), we can estimate how much New South Wales cooled and then warmed. The sum of these values gives us the net change, a value that if we then multiple by a total period of 124 years, gives an indication of the rate of cooling per century. This trend of -0.021 degree C per century suggests that the earlier cooling was almost, but not completely, negated by the later warming. To be clear, the overall temperature trend for New South Wales, calculated from the unhomogenized maximum temperatures as recorded at locations with long series, is one of cooling.

Table 1. Temperature Trends NSW

Locations in New South Wales (including Canberra) have been included that have a continuous temperature record for either the period from pre-1900 to 1960 or post-1960 to 2013. A negative number represents cooling, a positive number warming as measured in degree C per century.

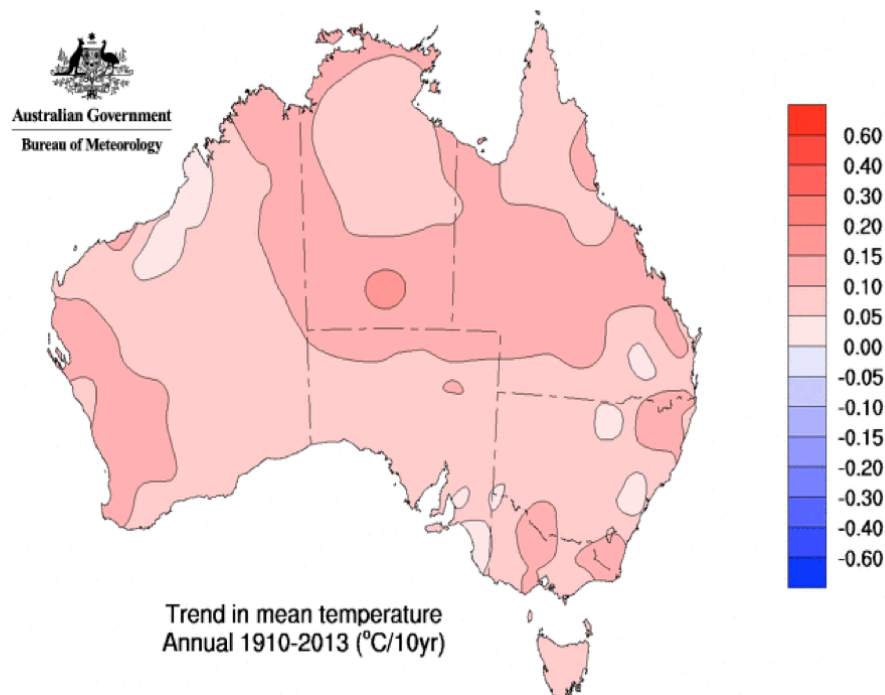
Location	T Max From beginning to 1960	Location	T Max 1960 to 2013
Bourke Post Office	-2.31	Parkes	4.40
Broken Hill	-2.55	Coonabarabran	1.4
Forbes Camp Street	-0.88	South West Rocks	2.34
Bathurst Gaol	-1.54	Williamtown RAAF	2.54
Wilcannia	-0.77	Coffs Harbour	1.85
Coonabarabran	-3.67	Wagga Wagga	3.15
Dubbo Darling Street	-2.83	Canberra Airport	3.48
Newcastle Nobbys Station	-1.82	Sydney Airport	2.17
Hay (Miller Street)	-2.63	Hay Miller Street	1.76
Deniliquin	-4.53	Moruya Heads	1.66
Walgett	0.89	Tibooburra Post Office	2.58
Cootamundra Post Office	1.34		
Moruya Heads	-3.0		
Cooma (Lambie Street)	-3.02		
Average	-1.95	Average	2.48

These statistics suggest a very different story to the Bureau's official mean trend of about 1 degree C per century for the period 1910 to 2013, Figure 10. Their value is greater than our calculation by more than a factor of 10 and in the direction of warming.

Henry Lawson wrote, "If you know Bourke you know Australia". So, how does taking this revisionist approach to the temperature record for Bourke, and its repetition in the media change our perception of Australia's past and our attitude to the future?

In *Nineteen Eighty-Four* Winston Smith knows that, "He who controls the present controls the past". Certainly the Bureau appears intent on improving the historical temperature record by changing it. In *Nineteen Eighty-Four* the Ministry of Truth oversees the propaganda. Certainly the Australian Broadcasting Corporation appears inclined to blindly repeat it.

Fig. 10. Official Trend as Mean per Decade



When Dr Jones, via our ABC, tells Australians it is getting hotter and hotter, he is alluding to an apocalyptic vision of a global warming Armageddon. But is this real, or just a story based on output from a computer model?

Perhaps the science of global warming has been somewhat corrupted by noble causes?

Let us conclude with a message from Burke. Not from Bourke the often hot and dusty town in this wide-brown land called Australia, but Burke the man. The Irishman Edmund Burke wrote, "The only thing necessary for the triumph of evil is for good men to do nothing." It's up to you to act in some way on the information we have presented in this paper, or to do nothing. We hope you will act, because if climate change is the greatest of moral issues, then the truth really does matter.

Thank you.

About the authors: Dennis Jensen is the federal member for Tangney in Perth with a PhD in material science from Monash University. Ken Stewart is a retired school principle and blogger who lives in Rockhampton in Queensland. John Abbot has a PhD in chemistry from McGill University in Montreal and is a professor at Central Queensland University funded by the B. Macfie Family Foundation. Jennifer Marohasy is a Noosa-based writer and researcher with a BSc and PhD from the University of Queensland.

Their recent publications in climate science include:

J. Abbot & J. Marohasy, 2012. Application of artificial neural networks to rainfall forecasting in Queensland, Australia, *Advances in Atmospheric Sciences* Vol. 29, Pgs. 717-730.

D. Stockwell & K Stewart, 2012 Biases in the Australian High Quality Temperature Network, *Energy & Environment*, Vol. 23, 10.1260/0958-305X.23.8.1273

J. Abbot & J. Marohasy, 2014. Input selection and optimisation for monthly rainfall forecasting in Queensland, Australia, using artificial neural networks, *Atmospheric Research*, Vol. 138, Pgs. 166–178.

J. Abbot and J. Marohasy, 2014. Using artificial intelligence to forecast monthly rainfall under present and future climates for the Bowen Basin, Queensland, Australia, *International Journal of Sustainable Development and Planning*. In press.

J. Abbot & J. Marohasy, 2014. Using lagged and forecast climate indices with artificial intelligence to predict monthly rainfall in the Brisbane Catchment, Queensland, Australia, *International Journal of Sustainable Development and Planning*. In press.

J. Abbot & J. Marohasy, (Submitted) Forecasting monthly rainfall in the Bowen Basin of Queensland, Australia, using neural networks with the Niño Indices for El Niño-Southern Oscillation, *Atmospheric Research*.

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