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The warming of Australia is man-made, but not by carbon dioxide

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ABSTRACT

Claims that Australia is warming result mainly from the anthropogenic biasing ofthermometer readings and have nothing to do with the changed composition of the atmosphere. Other factors are the misrepresentations of the natural oscillations of the climate, the cherry picking of time windows and the locations to magnify the warming, and the manipulation of the real thermometer readings by reconstruction or homogenization. The case of Alice Springs is discussed in detail as it is a unique location in the centre of Australia without any neighbouring stations to complicate the pattern recognition. Here the actual temperature measurements show no sign of warming since the end of the 1800s while the reconstructed temperature show the largest warming in Australia. The scientific debate on the difference between using actual measurementsandreconstructions raises several ethical issues.

TECHNICAL ISSUES BIASING THE WARMING ASSESSMENT

Claims that Australia is warming are mainly based on anthropogenic biases of the thermometer readings. Other factors are major modifications in land use, the formation of urban heat islands and the location of the thermometer close to an air conditioning unit ora car park. There is also misrepresentation of the natural oscillations and the cherry picking of time windows and locations to magnify the warming, and the manipulation of the thermometer reading by reconstruction or homogenization.

The Alice Spring temperature record is a clear example of this latter manipulation and it is analysed here with the help of a very simple mathematics and reference to the peer reviewed works on the subject.

The Australian Government Bureau of Meteorology (BOM hereafter) produced in 1999 a homogenised "*high-quality*" (HQ) dataset of annual mean maximum and minimum temperature series for Australia[1]. The primary purpose of this dataset was to enable reliable analyses of climate trends. Each station record was adjusted for discontinuities caused by changes in site location and exposure, and other known data problems.

Generally the high-quality records were homogenised from 1910, by which time most stations were believed to have been equipped with the current standard instrument shelter. 181 of the 224 temperature records reconstructed to an "*acceptable*" level were identified as being "*non-urban*" and suitable for trends analyses.

BOM updated in 2004 the dataset by using new methodologies to assess whether a record was likely

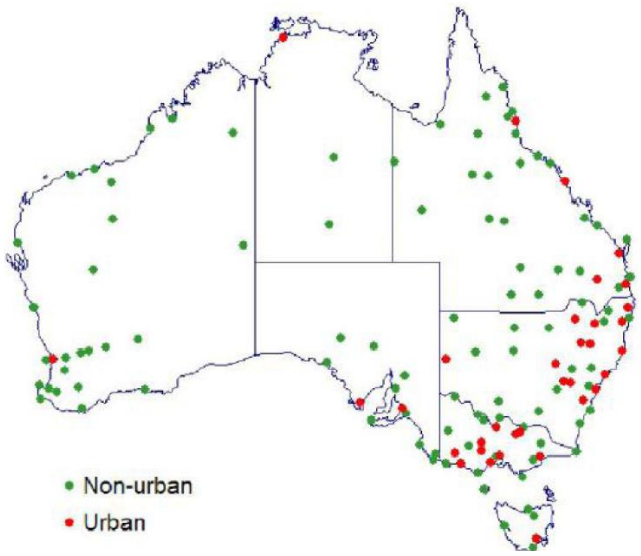

Figure 1: "High quality" data network

to have been contaminated by urban warming, and to use available comparison observation data in cases where a station had moved[2]. A non-urban set of 99 stations from the updated dataset was used to prepare the maps of trends in temperature.

Figure 1 presents the location of the HQ stations[2]. In the centre of Australia there is only Alice Spring.

Trend maps were produced by the BOM[3] suggesting warmings much higher than the raw "*high quality*"measured data were showing.

The trend maps were made available over different time windows from 1910 to present up to 1970 to present. These maps, updated 2011, were showing mean temperature gradients up to 0.15 - 0.20 °C/decade over the longer time window, and up to 0.30 – 0.40 °C/year over the short time window, with the highest values in the hot centre of Australia close to the Alice Springs location[4].

The work[4] analysed the raw data of the only 3 stations of the Northern Territory of Australia included in the HQ data set. These stations are very far from each other and very far from the other HQ stations of the neighbouring states, far enough to prevent any legitimate "*homogenization*".

The data for Alice Springs and Darwin were available over a longer time window with first measurements started at the end of the 1800s.

Over this longest time window, the warming trends for the maximum and minimum temperatures were 0.0094 and 0.0572 °C/decade for Alice Springs and -0.0246 and 0.0636 °C/decade for Darwin[4].

Over the same time window 1910 to 2011, the warming trends for the maximum and the minimum temperatures were actually 0.1147 and 0.0665 °C/decade for Alice Springs and 0.0512 and 0.0750 °C/decade for Darwin[4].

Even though the Tennant Creek recording started at the end of the 1800s, like Alice Springs and Darwin, the first complete year of data is only 1911.

For all the 3 locations, the measurement started in a Post Office location and was later moved to an Airport location.

Over the same time window 1970 to 2011, the warming trends for the maximum and minimum temperatures were actually 0.2702 and 0.2437 °C/decade for Alice Springs, 0.0817 and -0.0439 °C/decade for Darwin, and 0.0812 and 0.2263 °C/decade for Tennant Creek[4].

Considering the mean temperature as the average of maximum and minimum temperatures, the trend maps of 2011 were largely overrating the warming by a factor of 2 at the best, and over the longer time window since the end of the 1800s there was actually no warming at all in the measured data.

A similar lack of significant warming over the time window 1910 to present for Alice Springs, Darwin and Tennant Creek is also provided by the recent analysis of the raw data of same and other Australian locations of[5].

The warming rate for maximum, minimum and average of maximum and minimum temperatures are 0.0335, 0.1214 and 0.0775 °C/decade for Alice Springs, -0.0392, -0.0130 and -0.0261°C/decade for Darwin, and 0.1926, -0.0086 and 0.0920 °C/decade for Tennant Creek, where the first year of data is 1911 rather than 1910.

Why the selected data set and the interpolation of this data set is suggesting significant warmings while the supporting raw temperatures in key locations are showing much less warming is a problem of "*pal-review*" of the procedures followed by the BOM in their move from the raw temperatures to a dataset that permit "*reliable analyses of climate trends*".

The arbitrary corrections to the raw tempera-

ture data were the subject of many investigations, such as[6].

According to[6], the HQ was increasing the warming trends by 40% nationally and 70% in the cities. The independent analysts and Senator Cory Bernard put in a Parliamentary request to get the Australian National Audit Office (ANAO) to re-assess the BOM records. In response the BOM (possibly afraid of being audited and forced to provide all the data, code and explanations) replaced the HQ record with the Australian Climate Observations Reference Network (ACORN) data set[7]. Since the BOM changed the data set, the auditing by ANAO was not implemented. However, the ACORN data was even less transparent than the HQ data, providing the same or even more warmingand the same or even larger discrepancies compared to the raw temperature data.

Figure 2 presents the BOM latest trend maps and time series for temperatures (images downloaded August 25, 2014from[3]).

Most of the warming appears to be produced in the centre of the Australian desert, yet here the Alice Springs Post Office and the Alice Springs Airport thermometers show no warming since 1878.

Figure 3 presents the warming trend for Australia proposed in the latest state-of-the-climate report by BOM and CSIRO[8]. For Alice Spring, the warming trend is above 2 ºC since 1910.

To check how the ACORN temperature records compare with the truly measured temperatures we propose here the maximum and minimum monthly averaged temperatures for Alice Springs shown in Figure 4.

According to the BOM survey of Australian stations measuring maximum air temperature with more than 50y of data and 80% complete record, produced 12 February 2009[9], there are 175 stations in total. However, if we limit our attention to the stations already open in 1940 and still open in 2009, the number drops drastically to 34. The stations already open in 1930 and still open in 2009 are only 22, and those open in 1910 and still open in 2009 only 17. Requiring completeness > 95%, this number drops to 12. Australia has a total Surface area (sq. km) of 7,741,220. The data coverage is clearly insufficient.

If in addition to the lack of data there is a manipulation of the temperature records (as in the case

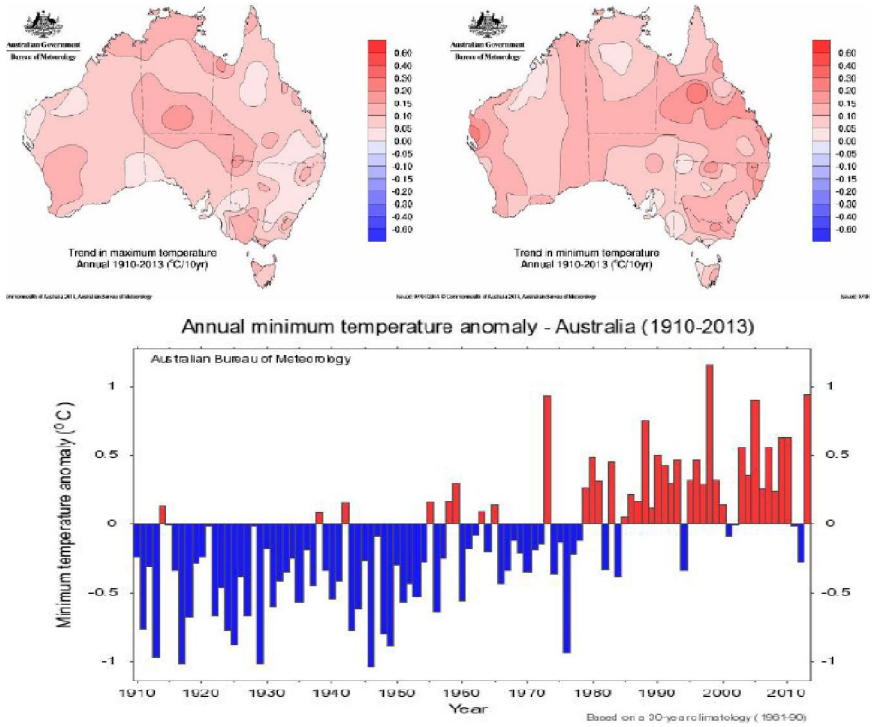

Figure 2 : Latest trend maps and time series for temperatures (image downloaded August 25, 2014 from [3]). Most of the warming is allegedly produced in the centre of Australian, where the Alice Springs Post Office and the Alice Springs Airport thermometers show no warming since 1878

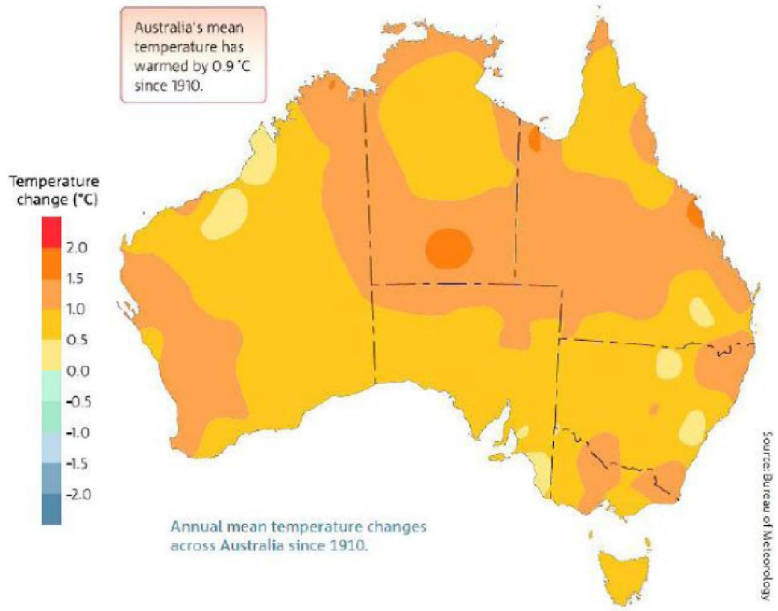

Figure 3 : Warming trend for Australia from the latest state-of-the-climate report by BOM and CSIRO [8]. For Alice Springs the picture claims a warming since 1910 above 2 ºC, larger than the true average ½·(T_{max}+T_{min}) warming over the same period of about 0.75 ºC, but also larger than the average ½·(T_{max}+T_{min}) ACORN warming of about 1.5 ºC.

of Alice Springs) or the removal from the data set of sites with no warming (as in the case of Ballarat), then the reliability of the BOM exercises is minimal.

Figure 4 shows how the temperatures from 1910 to 1950 were made 0.8 ºC cooler than the measured values by "*homogenization*" and "*use of latest analysing techniques*" in the ACORN data set. This produces a warming trend that simply does not exist in the measurements. Additionally, the ACORN time window neglects the fact that the maximum temperatures of the 1800s were larger than the latest "*record high*" temperatures.

When all the data are considered, the truly measured maximum temperatures are warming 0.003 ºC/decade, while the reconstructed maximum temperatures are warming 0.180 ºC/decade.

The truly measured minimum temperatures are warming 0.042 ºC/decade, while the reconstructed minimum temperatures are warming 0.136 ºC/decade.

Limiting the attention to the data available since 1910, the truly measured maximum temperatures are now warming 0.110 ºC/decade, while the reconstructed maximum temperatures are warming 0.173 ºC/decade.

The truly measured minimum temperatures are now warming 0.046 ºC/decade, while the reconstructed minimum temperatures are warming 0.133 ºC/decade.

For Alice Spring Figure 3 claims a warming since 1910 above 2 ºC, larger than the true average ½·(T_{max}+T_{min}) warming over the same period of about 0.75 ºC, but also larger than the average ½·(T_{max}+T_{min}) ACORN warming of about 1.5 ºC.

Regarding the map with the time window 1970 to present proposed by the BOM since the early 2000s as a proof of an increasing warming presently occurring and the refusal to produce a map with the time window 1980 to present "*because 30 years of data are not enough*", the real motivation is that it is well known that the temperatures have been oscillating about a mild warming trend with oscillations up 1910 to 1940 and 1970 to 2000, and down 1880 to 1910, 1940 to 1970, and 2000 to present (and very likely 2030)[10-13].

The start of the time window in a valley of the peak and valley multi-decadal oscillations in 1970 is therefore particularly misleading and BOM should avoid any claim of increased warming since the 1970 misrepresenting the natural oscillations.

If the window 1970 to present was legitimate in

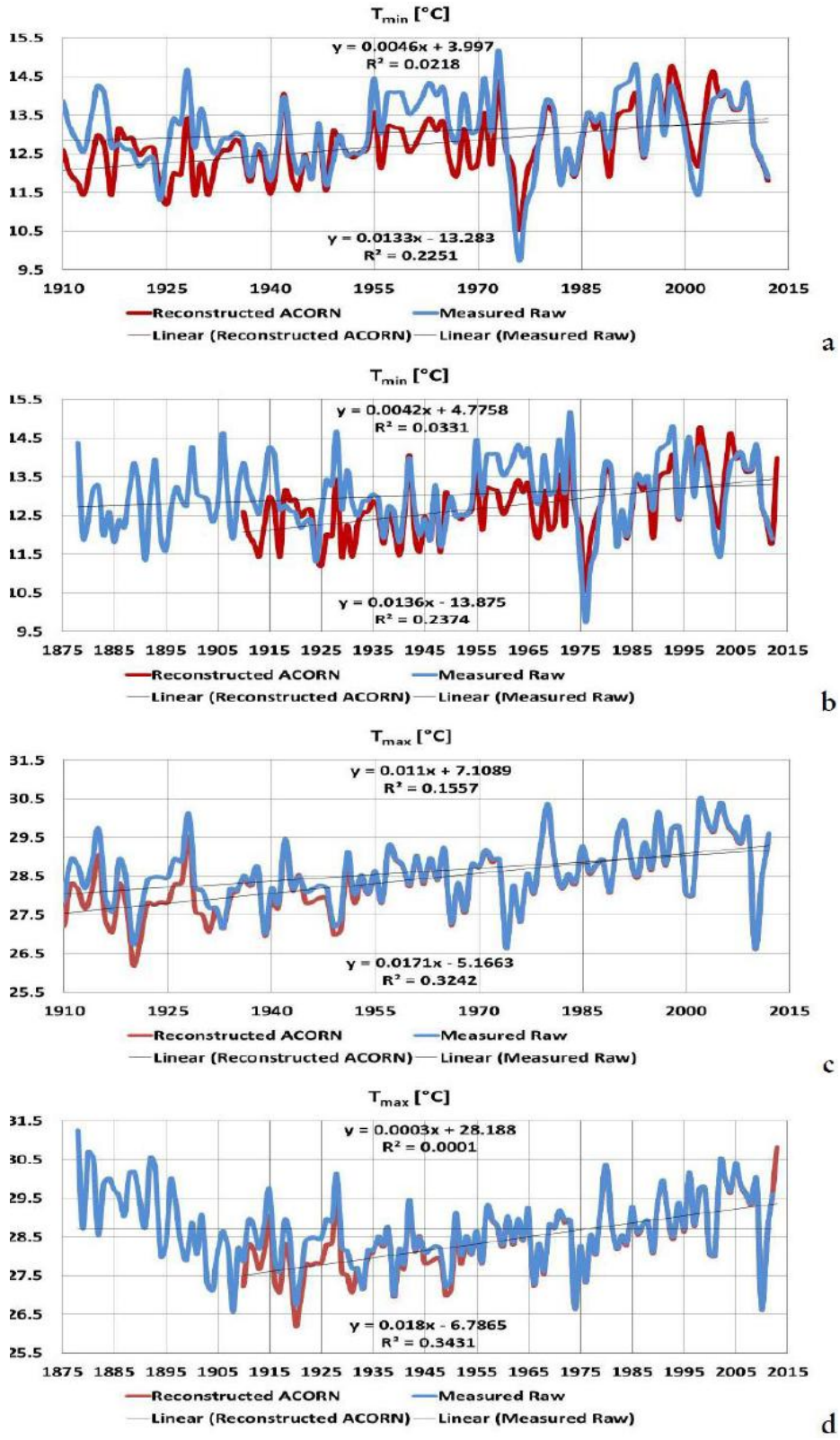

Figure 4 : Alice Spring result – Reconstructed ACORN vs. RAW measured minimum and maximum temperatures. The time window of the reconstructed data magnifies the warming. The reconstructed data also increases the warming by making lower the temperatures of the past. The measured values of Figures b and d show no warming at all since 1888. The measured values of Figure a and c show a much smaller warming of 0.46 and 1.1 °C/century of minimum and maximum temperatures since 1910

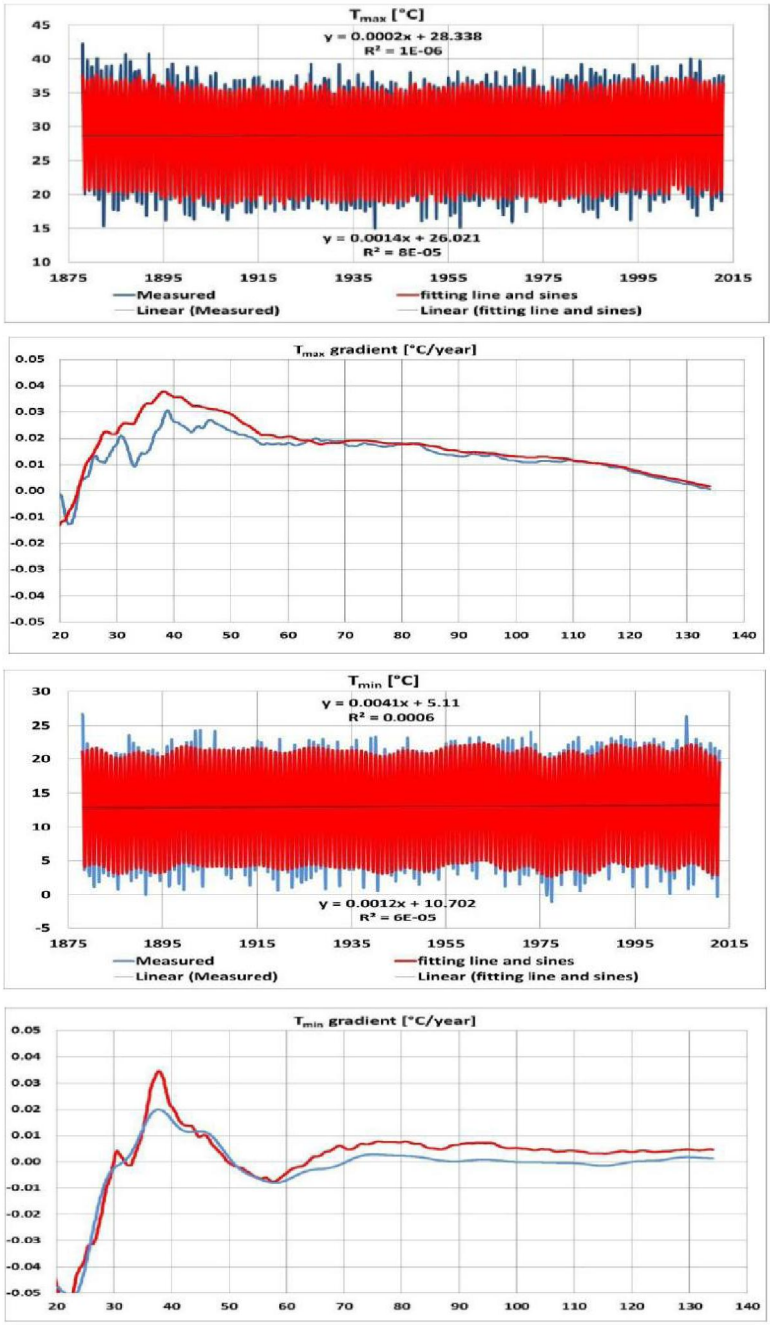

Figure 5 : Alice Spring raw measured minimum and maximum temperatures and their fitting with a line and sines. Even time series perfectly oscillating about a constant trend produces on short windows much higher than legitimate warming. Particularly misleading is the start of the time window in a valley of the peak and valley multi-decadal oscillations, for example about 1970, when it is well known that the temperatures have been oscillating about a mild warming trend up 1910 to 1940 and 1970 to 2000, and down 1880 to 1910, 1940 to 1970, and 2000 to present

the early 2000s, why the window 1980 to present is not legitimate in the early 2010s is mystery. Is the length requirement only claimed when not supporting an increase warming?

To show the influence of the very well-known multi-decadal oscillation and in particular the quasi-60 years[10-13] present in both temperature and sea level records worldwide, Figure 5 presents the raw measurements of maximum and minimum temperatures in Alice Spring and their fitting with a line and multiple sinuses.

If an experimental distribution $\{x_j, y_j\}$ j=1, …,

m represents the m monthly average temperature observations y_j at the time x_j, the classic estimation of the rate of rise is based on the linear fitting:

$$y^+(x) = \left(y_0^+ + a^+ \cdot x\right) \quad (1)$$

where y^+ is the temperature, x the time, and y_0^+, a^+, are the fitting coefficients. a^+ is the temperature gradient.

The residual:

$$\varepsilon_j^+ = y^+(x_j) - y_j = \left(y_0^+ + a^+ \cdot x_j\right) - y_j \quad (2)$$

Is the error that includes mostly periodical oscillations, noise, fitting inaccuracies or eventually the influence of global warming (if detectable) that would in case produce a departure from the linear trend.

The fitting with a line and sines has the expression:

$$y^*(x) = \left(y_0^* + a^* \cdot x\right) + \sum_{i=1}^{n}\left[A_i \cdot \sin\left(\pi \cdot \frac{x - x_{c,i}}{w_i}\right)\right] \quad (3)$$

where y^* is the temperature, x the time, n the number of sines and y_0^*, a^*, A_i, $x_{c,i}$, w_i are the fitting coefficients. a^* is the temperature gradient, and A_i, $x_{c,i}$, w_i are the amplitudes, phases and periods of the oscillations.

The residual

$$\varepsilon_j^* = y^*(x_j) - y_j = \left(y_0^* + a^* \cdot x_j\right) + \sum_{i=1}^{n}\left[A_i \cdot \sin\left(\pi \cdot \frac{x_j - x_{c,i}}{w_i}\right)\right] - y_j \quad (4)$$

is the error that includes noise, fitting inaccuracies, periodic oscillations not exactly sinusoidal, periodic oscillations that are not included or eventually the influence of global warming (if detectable) that would produce a departure from the linear trend.

Fitting of the distribution $\{x_j, y_j\}$ j=1, …, m with equation (1) returns the warming rates already presented in Figure 4.

In case equation (3) is used, it is possible to also compute the periodicities, amplitudes and phases of the sinusoidal oscillations.

Worth of mention, oscillations of a given periodicity not perfectly sinusoidal may be fitted with a sinusoidal oscillation of same periodicity plus another sinusoidal oscillation of shorter periodicity. Therefore equation (3) may return spurious sinusoidal oscillations because of oscillations of longer periodicities not sinusoidal.

Computation of the raw periodogram of the univariate time series with the 95% Kolmogorov-Smirnov confidence intervals by using the free software[16] returns decadal and multi-decadal periodicities of 34, 13.5 and 11 years for the monthly average maximum temperatures and of 27-45, 13.5 and 9 years for the monthly average minimum temperatures. A longer periodicity is evident especially in the monthly average maximum temperatures time series.

Similar results are obtained by using equation (3). Periodicities of 70, 36 years and 11.5 years are detected for the monthly average maximum temperatures and periodicities of 44 years, 30.5 years, 15 years and 11.5 years are detected for the monthly average minimum temperatures.

The residual of the fitting with equation (3) is distributed about a zero trend to show inaccuracies of the fitting approach but no increasing warming.

Fitting with equation (1) the temperatures time series is the classic approach used to compute the warming trends. The Alice Spring record covers the period January 1878 to December 2012. Rather than using the measured data $\{x_j, y_j\}$ or fitted data $\{x_j, y^*(x_j)\}$ j=1, …, m, with 1 the first recorded month (January 1878) and m the latest (December 2012), we may also consider at any time x_n the measured data $\{x_j, y_j\}$ or fitted data $\{x_j, y^*(x_j)\}$j=n, …, m. These two figures permit us to understand the effect the natural oscillations have on the apparent temperature gradient when using short time windows in Alice Spring.

Not surprisingly, the warming rate has a peak at about 40 years' time window, corresponding to the time window starting in the year 1970 in a clear valley of the peaks and valleys oscillations, and it is much lower with 30 or 60 years' time windows by a factor of 2.

This latest picture clearly indicates that BOM (and others) should not play with the multi-decadal oscillations to suggest wrong conclusions, as Figure 4 suggests the BOM (and others) should not correct the truly measured trends always in the direction of more warming and always by lowering the temperatures of the past.

ETHICAL ISSUES BIASING THE WARMING ASSESSMENT

It is worth of mention that while the temperatures for Alice Spring and global for Australia have been "*massaged*" in addition to be "*cherry-picked*" with the clear intent of suggesting a warming cleared out of urban heat islands much larger than the legitimate, the rainfall for Australia has been so far only "*cherry-picked*" to show draught in some subregions or over very specific small windows, while the overall trend is actually of increasing rainfall over the century obviously subject to about same multi-decadal oscillations of temperatures.

Figure 6 presents the Australian annual total rainfall average map and time series 1900 to present (from [3], image downloaded August 14, 2014) according to BOM. Over the century, the rainfall is not reducing but actually increasing. For Alice Spring, the rainfall is increasing similarly to the national

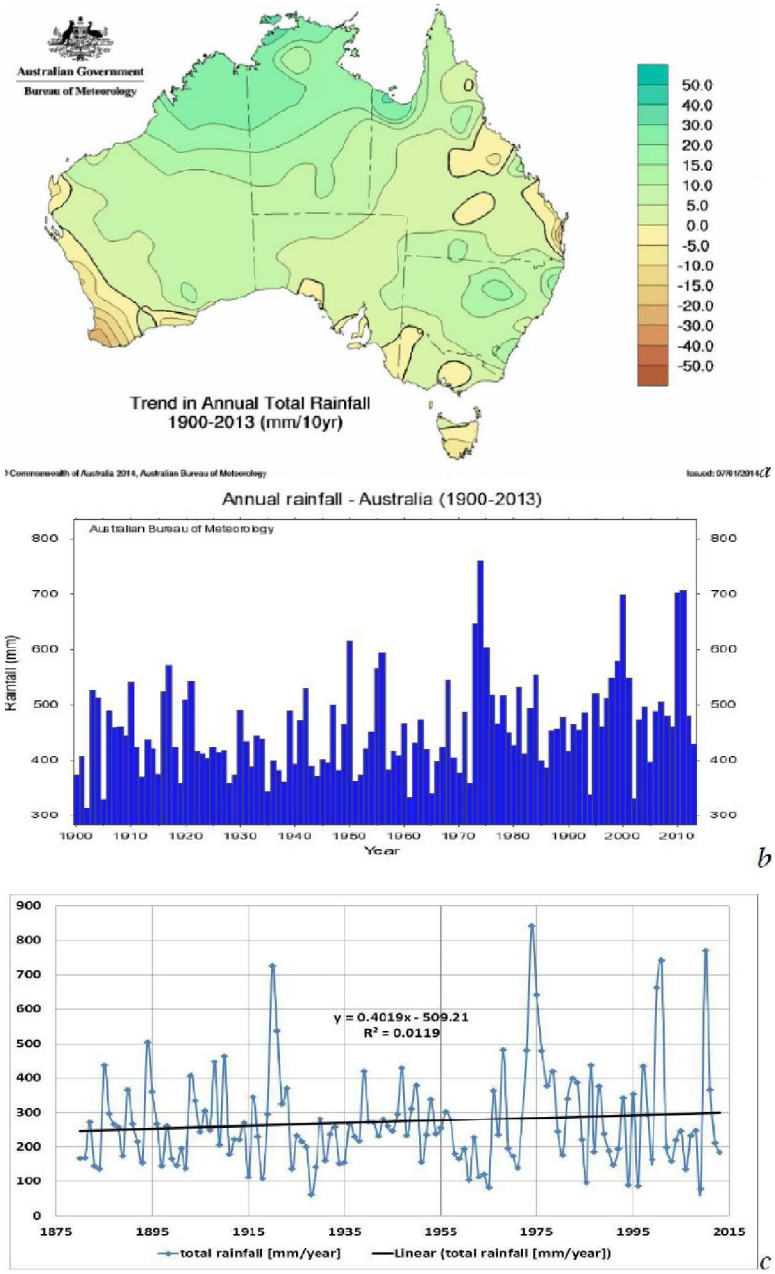

Figure 6 : a, b: Australian annual total rainfall average map and time series 1900 to present (from [3], image downloaded August 14, 2014). Over the century, the rainfall is not reducing but actually increasing. c: Alice Spring rainfall. The rainfall is increasing here as almost everywhere else in Australia

average.

Computation of the raw periodogram of the univariate time series with the 95% Kolmogorov-Smirnov confidence intervals by using the free software[16] returns decadal and multi-decadal periodicities of 72, 29 and 13 years for the monthly total rainfall, not that far from the temperatures periodicities.

Why the only statements about the Australian rainfall are only of draught in selected subregions and in selected time windows when the global trend is actually the opposite is another example of biased information.

BOM states[8] "Rainfall averaged across all of Australia has slightly increased since 1900. Since 1970, there have been large increases in annual rainfall in the northwest and decreases in the southwest. Autumn and early winter rainfall has mostly been below average in the southeast since 1990." However, being globally increasing rainfall not a scaring message, the focus is shifted from the "big picture" to the "small picture" that fits the global warming theorem.

"Since 1970 there has been a 17 per cent decline in average winter rainfall in the southwest of Australia. The southeast has experienced a 15 per cent decline in late autumn and early winter rainfall since the mid-1990s, with a 25 per cent reduction in average rainfall across April and May. Declining rainfall in the southwest has been statistically significant over the recent period, and has occurred as a series of step changes. The decline in this region has also been characterised by a lack of very wet winters. The cool season drying over southern Australia in recent decades, and evidence of increased rainfall over the Southern Ocean, is associated with changes in atmospheric circulation. While natural variability likely plays a role, a range of studies suggest ozone depletion and global warming are contributing to circulation and pressure changes, most clearly impacting on the southwest. Uncertainties remain, and this is an area of ongoing research. The reduction in rainfall is amplified in streamflow in our rivers and streams. In the far southwest, streamflow has declined by more than 50 per cent since the mid-1970s. In the far southeast, streamflow during the 1997–2009 Millennium Drought was around half the long-term average".

Not surprisingly, Nature Geoscience recently focused on the small reductions of rainfall in selected Australian subregions that is wrongly attributed to the global carbon dioxide emission[14,15].

Why nobody writes about the global carbon dioxide emission increasing the rainfall of Australia but only reducing somewhere the rainfall is a mystery. As a mystery is the fact nobody discusses that the net carbon dioxide fluxes measured for Australia are reducing and not increasing.

The Greenhouse Gases Observing Satellite (GOSAT) satellite[17] provides the first measured CO_2 flux data. A positive flux represents a net emission and a negative flux represents a net sequestration. GOSAT observes infrared light reflected and emitted from the earth's surface and the atmosphere computing column abundances of CO_2 (and CH_4) from the observational data. The column abundance is the number of the gas molecules in a column above a unit surface area.

The carbon dioxide flux estimates based on the observational data of GOSAT[18] shows Australia is a top net sequestering country, not a top net emitting one. Figure 7 (from[18]) presents the geographical distribution of the fluxes.

The net flux emission less sequestration shows this parameter is not driven by the carbon dioxide emissions due to "*certain forms of human activity*". Other phenomena appear more relevant.

The GOSAT measurements have been the subject of more than 140 scientific papers published in the peer review[19]. In none of them has the reliability of the measurement has been questioned.

The major issue preventing a proper assessment of the warming trends (or the draught issues) is the "*pal-review*", or even the "*self-assessment*", and in addition the "*criminalization*" of the scientists holding "*non-warmist*" opinions that get their reputation ruined immediately after they try to propose their views.

The discussion of the Alice Spring temperature record is a good example of "*pal-review*" as described below.

The work[4] was accepted on the journal Theo-

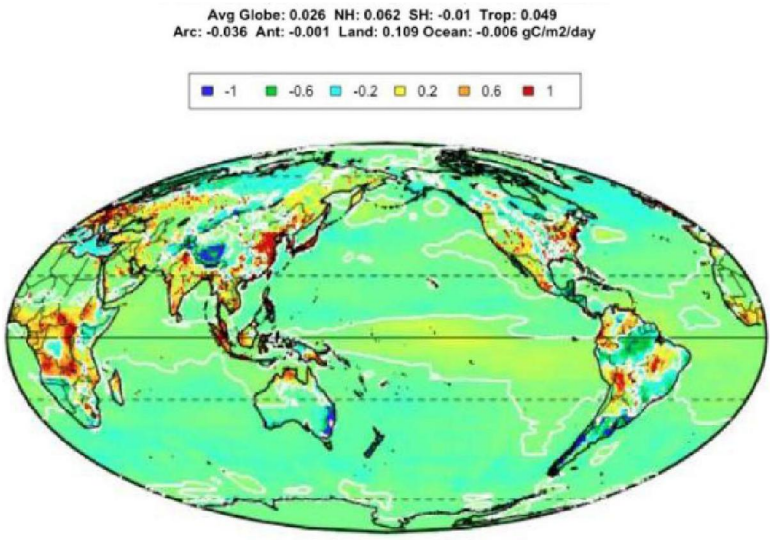

Figure 7 : Geographicaldistribution for the year 2010 of GOSAT net (emitted less sequestrated) CO_2 fluxes. The white colored contour lines show 0 gC/m^2/day separating net emitting from net sequestering zones. The Figure is reproduced from [17] (Courtesy of Willy Eschembach). Australia is with Brazil, Argentina and Canada a top sequestring country. If the GOSAT result is reliable, as never questioned so far in the peer review of the more than 140 scientific papers published[18], then policy decision should be based on this scientific information rather than on wishful thinking lacking of any scientific backgound

retical and Applied Climatology (TAAC) after a careful peer review under the supervision of the editor K. Higuki who left the editorial board immediately after the paper was accepted.

After the paper was published, the editor in chief H. Grassl refused to consider another submission by the same author of[4], rejecting the paper without sending out to reviewers with the singular explanation: "Sending your paper to reviewers would with high probability lead to declines or no answers and could - if reviewers accept - also damage the reputation of the editorial board. Therefore I reject your paper."

After some months the editor in chief H. Grassl wrote to the author of[4]: "today I have accepted after some minor changes asked for by reviewers a paper by Trewin (Comment to Boretti (2013)) for publication in TAAC, which comments on your earlier paper published last year in TAAC. When it is online (in about a month) you can either look at it on the TAAC website or ask me to send it to you as published. You have then the possibility to comment. Your comments will also go through a reviewing process."

It is certainly normal that a scientist write to the editor of a journal asking to comment a paper previously published on that journal by another scientist. However, ethics in publishing would require that the handling editor inform immediately the author of the commented paper of the submission circulating to him/her the comment and asking him/her a reply. The comment and the reply are then sent out for review by independent reviewers not having conflicts (or convergence) of interests with one of the parties same time for possibly contemporary publication.

In this case, what happened next was that the reply was sent out for review to the author of the comment himself Blair Trewin or a very close relative to get obviously rejected. As the editor in chief H. Grassl informed the author of[4]: "Reviewers' comments on your work have now been received. You will see that they are advising against publication of your work. Therefore I must reject it."

The reviewers' comments are actually one single reviewer comment, very likely Blair Trewin himself or a close relative: "This paper replies to a comment by Trewin and Jones in which they challenged an earlier paper by the same author. In his reply, the author makes a number of claims and allegations about the Bureau of Meteorology high-quality station data being subject to "arbitrary correction" and "cherry picking" and manipulation in or-

der to overstate warming trends in regional time series of observed temperatures. However, none of these claims is actually backed up with robust evidence. The paper appears highly opinionated and does not meet minimum scientific standards as outlined below. Furthermore, the structure of the text seems confusing and in many places it is not clear what the author actually wants to say - which makes it difficult to assess the text as a whole but also points to large potential to shorten the text. It seems important to point the author to the available literature which documents the observational datasets under discussion. Referring to these documents might help to clarify at least some of the questions raised in this text.

- Trewin BC (2013) A daily homogenized temperature data set for Australia. Int J Climatol 33:1510-1529

- Trewin BC (2012) Techniques involved in developing the Australian Climate Observations Reference Network-Surface Air Temperature (ACORN-SAT) data set. CAWCR Research Report 49, Bureau of Meteorology, Melbourne, 103 pp

- Bureau of Meteorology (2012) Australian Climate Observations Reference Network (ACORN-SAT) station catalogue. Bureau of Meteorology, Melbourne, 120 pp".

The "*impartial*" reviewer not having a conflict (or a convergence) of interest with BOM surprisingly cites one minor paper by Blair Trewin plus one BOM internal report by Blair Trewin and another BOM document both not-peer reviewed as the most relevant literature on the subject.

This example does not seem a good case of rigorous peer review but exactly the opposite, a case of "*pal-review*" where "*warmist*" researchers are able to bias in their favour the scientific debate.

The author of[4] was incidentally also the subject of contemporary accusation of unethical behaviour *"by an individual with a clear request that their identity remain confidential"* lodged with the editor of a prestigious journal where the author of [4] published another paper having nothing to do with the climate debate, an unfortunate coincidence however regularly occurring when writing papers on climate opposing the intergovernmental view point on climate.

CONCLUSIONS

The assessment of the warming is biased by technical and ethical issues

Urban heat island and other anthropogenic factors having nothing to do with the increasing carbon content of the atmosphere increase the warming in a scattered data set where the measurements for the past are mostly missed.

A proper assessment would require unbiased values collected consistently and continuously in a significant number of locations covering the area under study over more than 100 years to clear the multi-decadal oscillations. These data are not certainly available for Australia.

If technically the data do not permit to support strong warming conclusions, nevertheless the political pressure force climate scientists to support global warming claim or suffer discrimination and repression.

It is shown how the measured temperature record for Alice Spring shows no warming at all since the end of the 1800s and conversely by claiming impossible homogenization (there is nothing else measured around Alice Spring) the official maps suggest the most severe warming of Australia is occurring in Alice Spring.

Climate science definitely needs quality measurements, transparency, and free debate, and the BOM work has to be more open, stable, better justified and independently examined. The BOM climate records are not independently audited or assessed by any professional group, as data of this importance would be.

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