I am writing to offer comment to the panel. In brief I have major reservations about the quality of the ACORN-SAT database and more particularly the usage to which it is being put.

My major objection to the ACORN-SAT database is not that, compared to alternate climate reconstructions for the Australian continent, it exaggerates the recent warming trend. My key objection is not that it introduces biases that remove a cooling period between 1910 and 1960 that appear in alternate reconstructions and the raw data. Nor is my objection solely to the apparent fact that of all reconstructions ACORN-SAT shows the largest and fastest temperature rises and the poorest match to the original raw data of any comparable dataset.

My objection is the uses to which this data is put and the lack of appropriate caveats and qualifications when publicly presenting this data or publicly presenting conclusions drawn from this data.

For better or worse, the issue of catastrophic anthropogenic global warming has become a political issue in this country. It is my clear view that ACORN-SAT is being used to further one side of this debate and is being used in a way not justified by the data.

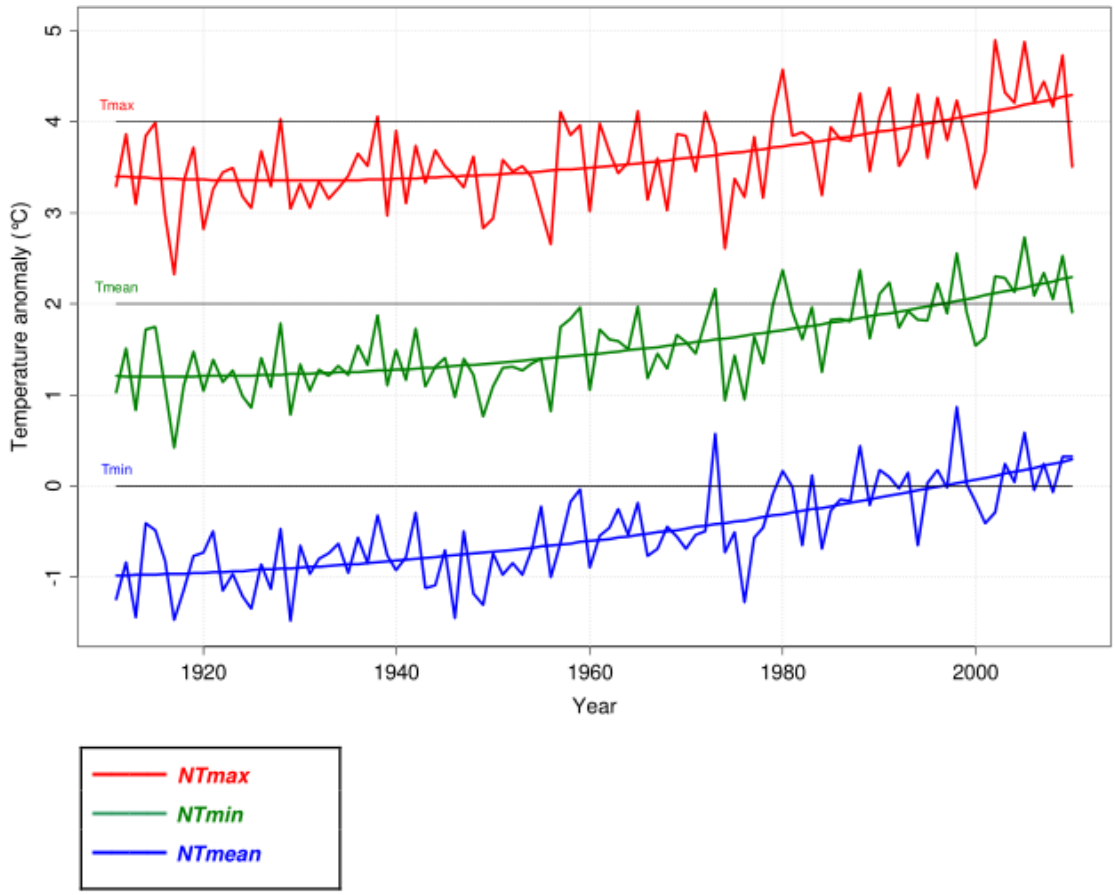
I have a strong view that whilst it is the job of the BOM to construct such analyses, it is not the job of the BOM to instruct debate or to take sides. Given that the issue of climate change has crossed the divide between science and politics, it is imperative that as a Government organisation the BOM be seen to be absolutely above any hint of partisan action. With ACORN-SAT it is hard to see that BOM is in fact impartial. In this case the BOM has created a database that:

- Removes historic cooling periods;
- Makes use of only a subset of all available data and is subject to unquantified errors due to station choice;
- Dismisses as incorrect past historic temperature records;
- Makes adjustments to past temperatures that have the net effect of upwardly biasing the existing temperature trends;
- Models trends using quadratic regressions that by definition trend to infinity and then use these models to predict apocalyptic future scenarios; and
- Presents all of the above in a way that fails to alert the reader of the exact nature of the transformation from the measured raw temperature sets to the final homogenised product.

Below, relying on the BOMs own peer review analyses and other independent sources, I hope to substantiate the above.

What does the Bureau of Meteorology/CSIRO peer review paper says about ACORN-SAT

Report 3b for the Independent Peer Review of the ACORN-SAT dataset, "On the sensitivity of Australian temperature variability and trends to analysis methods and observations networks", is a very interesting paper both for what it says and what it does not say. Figure 3 on page 14 of this report graphs the annual temperatures anomalies based on ACORN-SAT. This is copied below.



Note the graphs are progressively offset for visual quality, Tmax = maximum temperature, Tmin = minimum temperature and Tmean = mean temperature. The regression lines are quadratic regression lines.

The text goes on to discuss various alternate climate reconstructions. It details five other BoM temperature analyses and eleven other international reconstructions.

Interestingly, it graphs none of these in the format of table 1. This would have made a direct visual comparison possible. The report does graph the mean average differences (MADs) between many of these datasets and ACORN-SAT. These graphs are very informative. They clearly show a very distinct pattern. The great majority of these show that ACORN-SAT is not neutrally biased with respect to the other reconstructions but varies in a systematic way over the time range of ACORN-SAT.

To help show what I mean a copy of the MADs for Tmean for the ACORN-SAT database compared to the alternate BoM climate reconstructions is copied below. This is Figure 7 of page 22.

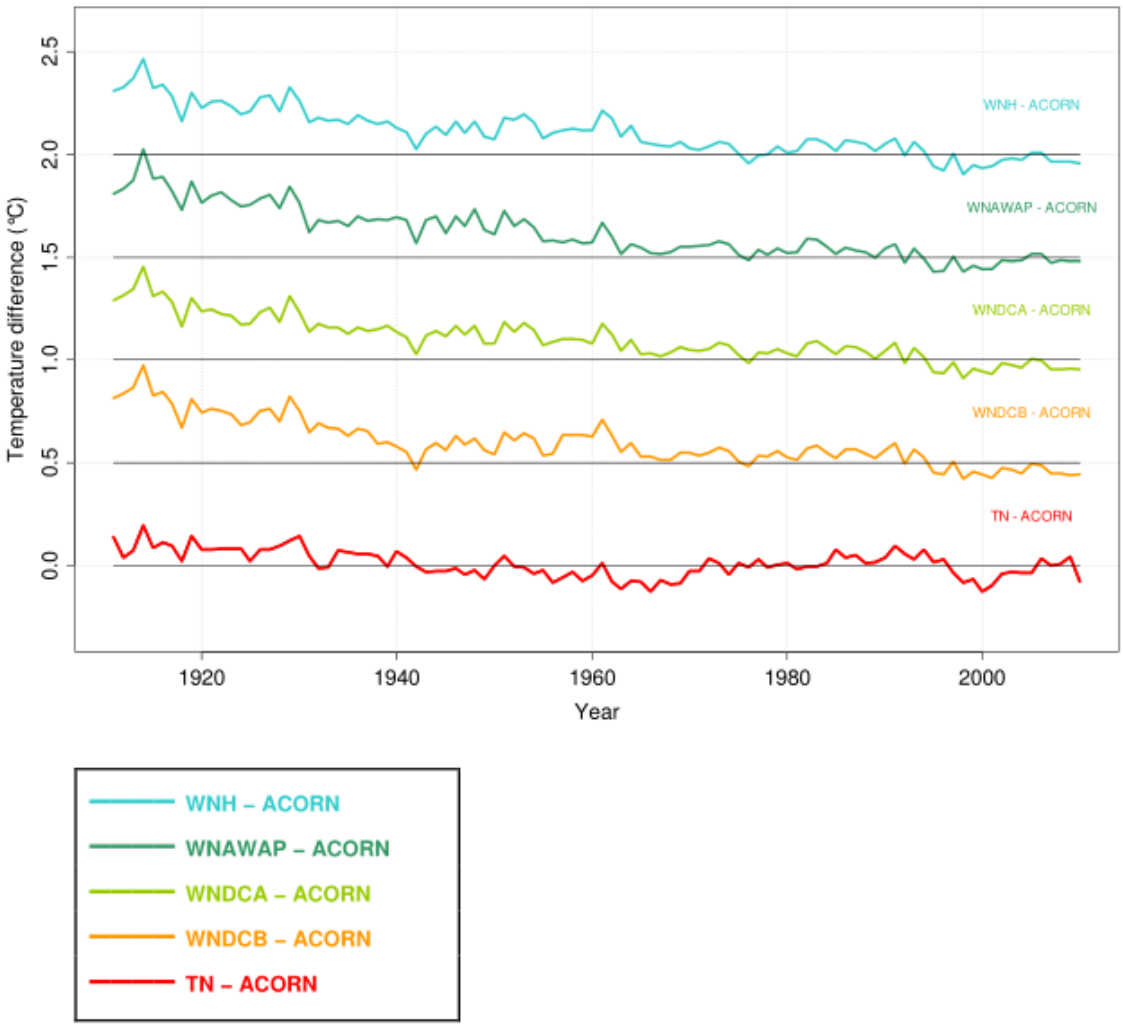


Figure 7: Comparison of *NTmean* time series (1911-2010). The differences plotted are TN – ACORN, WNDCB – ACORN, WNDCA – ACORN, WNAWAP – ACORN and WNH – ACORN (in °C). All contributing time series are anomalised with respect to the 1981-2010 period prior to the calculation of the difference between pairs of time series. Time series are progressively offset in the vertical for visual separation. Black lines denote the zero anomaly.

There are three things to note here. The first two are that the differences are not random and they are not neutral. Except for the last comparison they all clearly slope downward left to right and are clearly above the black zero anomaly lines. The third thing to note is the direction of this bias. The first line above plots the difference of WNH – ACORN (where WHN stands for Whole Network Hybrid analysis). Since the MADs for data points around 1910 are about 0.5°C above the zero anomaly line this indicates that ACORN temperatures are actually this amount lower. So the bias between these two is that ACORN in comparison to WHN is cooler at the beginning of the data period and warmer at the end, or to put it in other words, ACORN shows a warming bias. The same pattern is repeated for nine international reconstructions. This is copied on the next page and comes from Figure 8 on page 23 of Report 3b.

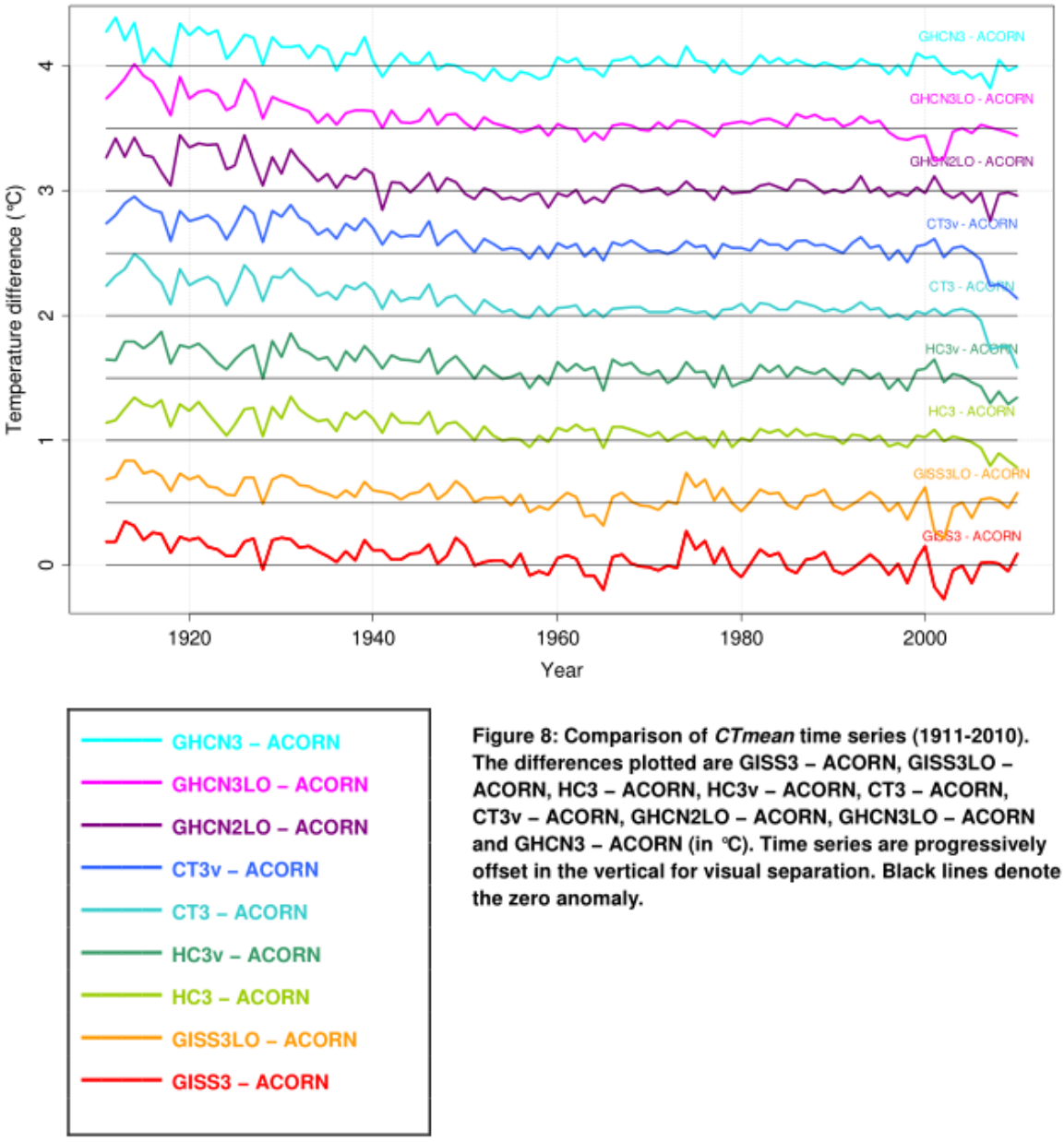


Figure 8: Comparison of *CTmean* time series (1911-2010). The differences plotted are GISS3 – ACORN, GISS3LO – ACORN, HC3 – ACORN, HC3v – ACORN, CT3 – ACORN, CT3v – ACORN, GHCN2LO – ACORN, GHCN3LO – ACORN and GHCN3 – ACORN (in °C). Time series are progressively offset in the vertical for visual separation. Black lines denote the zero anomaly.

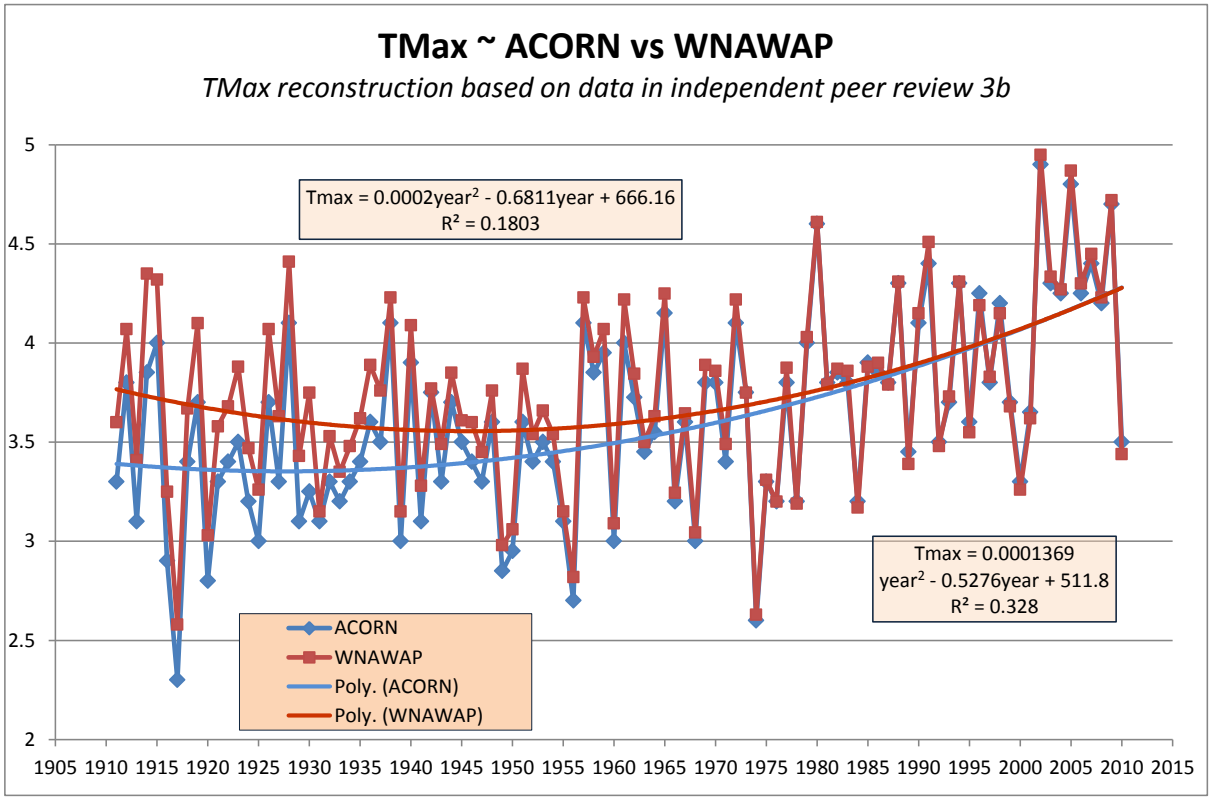
Again all of these climate reconstructions for the Australian region show MADs that are not random, not neutral and indicate that ACORN has a net warming bias over time.

Note: This is not to say that ACORN is wrong and the 13 alternate reconstructions that show a different historic temperature pattern are more accurate, but it does raise the bar and puts the onus on ACORN to show why these others are so different and why they are incorrect. The authors of this peer review appear to aver this general principle when on page 4 of the report they conclude, **"The greater the degree of consistency of the results across the different grid sets, the more confidence can be placed in the robustness of the derived trends and variability."** Curiously having stated this so clearly, they either fail to see that an inconsistency exists or have chosen not to detail and discuss this conflict in their report.

Also of interest is that the remaining datasets, all of which are based on satellite as opposed to surface measurement, are neither graphed nor discussed nor tabled. Even though these start in 1979, their omission is unfortunate and a major oversight as this would have added clarity to the

most recent period. The over 30 years of satellite data is quite enough time to be able to conduct a meaningful comparison.

To provide some clarity to what has been said above I have recalculated, using graphical techniques, Tmax for both ACORN-SAT and WNAWAP. I've used WNAWAP both because it seems fairly representative of the MAD sets above and because it is one of two reconstructions that that also appear in tabular form. The other TN is the only alternate reconstruction that on first glance is similar to ACORN and again is very unlike the other 13 MAD data lines.



The blue line is the ACORN-SAT line for TMax copied from figure 3 on page 14 of the peer review paper 3b. The adjustment made to obtain the red WNAWAP line is as per figure 5 on page 19 of the same paper. For fun I have added the BoM preferred quadratic regression lines for both and calculated the R^2 goodness of fit for each trend line. Although the goodness of fit is quite poor for both reconstructions, and in this case basically explains almost nothing about the data, it is interesting to note that using the quadratic equations given for each trend line, in the year 1AD the temperature according to WNAWAP was a substantial 154°C hotter than ACORN which indicates a relatively mild 512°C!

Frivolity aside, the immediate thing to notice here is that the initial quadratic trend line of WNAWAP suggests not the continual and accelerating temperature rise of ACORN-SAT but an initial period of cooling from 1910 to around 1950 and then a more gentle temperature rise afterward. In essence the two are very different and if WNAWAP is typical of alternate analyses then this would suggest that ACORN-SAT is not an accurate representation of actual climate. It also suggests that by simple reverse extrapolation that temperatures prior to 1910 may well have been hotter. Importantly the narrative has changed. Catastrophic warming becomes simply cyclic recovery.

Here WNAWAP stands for whole of network "Near-whole-network hybrid Australian Water Availability Project (AWAP) low-resolution analyses". Before advancing, it is interesting to see what is said about this dataset. Pages 6 and 7 of report 3b give the following information:

- **The dataset used is close to the whole network with only those sites that do not have a known altitude excluded. These exclusions add to around 4% of observations in the first 50 years and 1% in the last 50 years.**
- **A high resolution dataset is available and is virtually identical.**
- **The site anomalies tend to zero and the first-guess field is therefore an unbiased estimator.**
- **They were developed to provide improved spatial analysis rather than for analysing temporal change.**
- **The AWAP methodology, by using the observations as a predictor of an interpolated surface, effectively applies a spatial homogenisation to the temperature data at each time step. It is therefore instructive to compare results from AWAP to ACORN-SAT in the manner attempted here.**

None of these seem controversial. But let me repeat myself. There is a fundamental difference between these two datasets. That difference is that one database, based on an almost complete set of observations, shows an initial period of cooling whilst the other based on a limited set of sites does not show this at all. The peer review notes only, ***"Most of the temperature rise occurs in the second half of the study period (1961-2010), and over that later period the three analysis sets are in closer agreement, with respect to both total change and amplitude of interannual variability."*** (Page 15).

The table on this page shows for ACORN, TN and WNAWAP databases the total "quadratic change" in ^{o}C and the standard deviation of the "quadratic residuals" for maximum, minimum and mean temperatures for the periods 1911 to 2010 and the sub period 1961 to 2010. What it doesn't show is this data for the complimentary sub period 1911 to 1960. This can be calculated easily. The results are retabulated below.

Total Quadratic Changes:- Maximum Temperature

	Data Set		
Period	ACORN-SAT	TN	WNAWAP
1911-1960*	0.11	-0.05	-0.16
1961-2010**	0.79	0.78	0.70
1911-2010**	0.90	0.73	0.54

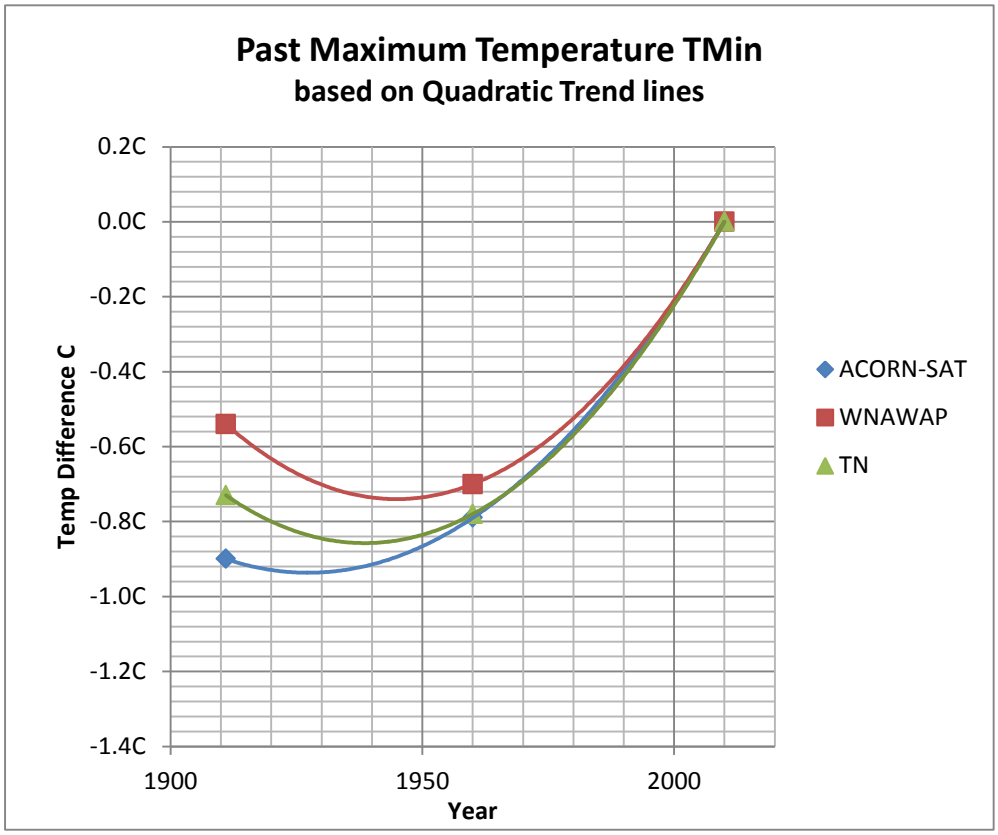
Total Quadratic Changes:- Minimum Temperature

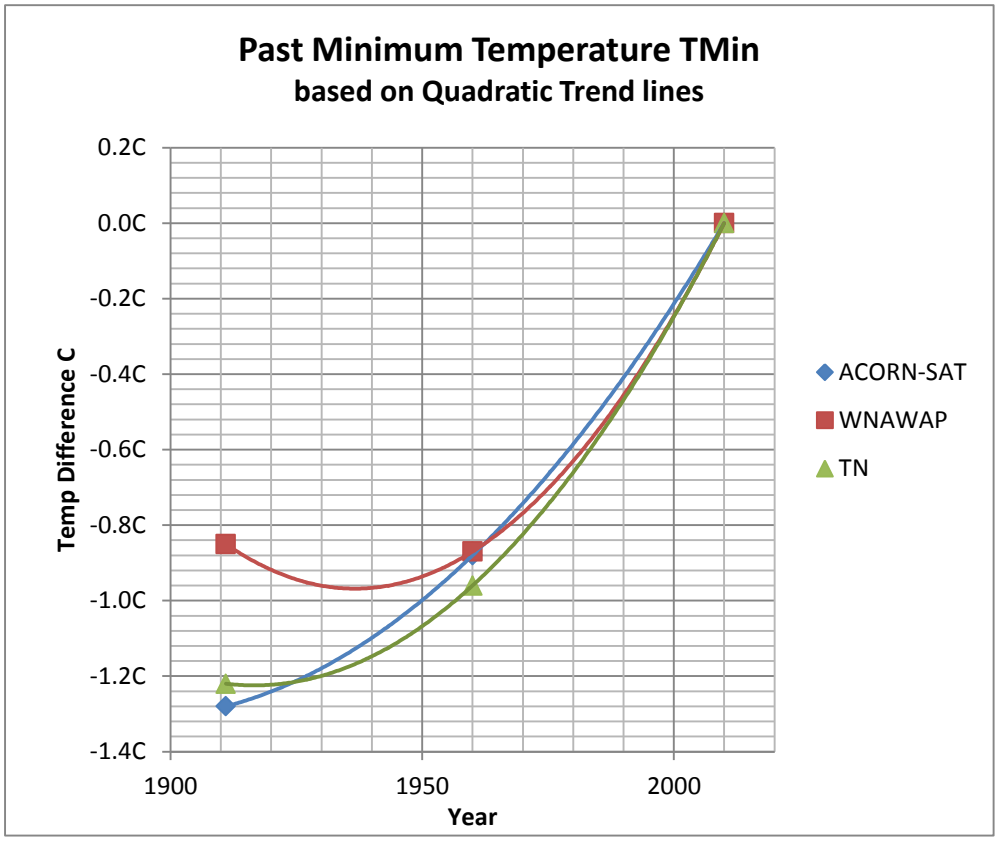
	Data Set		
Period	ACORN-SAT	TN	WNAWAP
1911-1960*	0.40	0.26	-0.02
1961-2010**	0.88	0.96	0.87
1911-2010**	1.28	1.22	0.85

** Calculated from data given*

*** Data given in table 1 of page 15.*

These figures can be used to show the quadratic trend lines for maximum and for minimum temperature change from 1911 to 2010 for each of the quadratic regressions associated with the three tabulated datasets above.





Which of these is closest to the true picture?

The report is correct to point out that from 1960 onwards all three datasets are in basic agreement, but whether they are also in agreement with the uncharted satellite data is left unsaid. The critical point of difference is clearly the "unmentioned" initial period between 1911 and 1960. Was this period cooling? If my reading is correct that the remaining unsighted datasets basically agree with WNAWAP and not with ACORN or TN, then the most logical conclusion is that it most probably was. If it was cooling then a second question arises. Was the period immediately before 1910, a period that included the famous federation drought of 1895 to 1902, even hotter?

What then are the key differences between ACORN, TN and WNAWAP?

It would have been nice for the report to have listed in table form all of the characteristics of each dataset so that direct comparisons would be immediately visible, perhaps in much the same way consumer magazines will rate various products. Headings might include, base period(s) used, site numbers used, Barnes successive corrections applied, altitude adjustments, homogenisations applied, gridding size,etc.

As far as can be seen there are three key differences:

1. TN and ACORN-SAT do not make use of the full network of sites whereas WNAWAP and the other Australian datasets make use of the whole network or near whole network. ACORN-SAT has around 50 sites available in 1910 rising to 112 in 2010. Of these only 100 are used in the analyses. For whole network analyses site numbers vary between 280 in 1910 to 800 around 1970. The bureau's peer review report says on page 18. ***"An unresolved question is how much of the differences in the early part of the record is due to sampling variability arising from a sparse network in the ACORN analyses."*** The issue, in brief, is not settled. I have an intuitive feel that the greater the number of sites, the better the resolution. For the period 1910 to 1911 "ACORN" use 50 to 57 sites across Australia whilst the alternate "WNAWAP" uses around 300 to 600 sites across Australia. Clearly the WNAWAP has the better spatial resolution by a big factor!

2. The second difference is that WNAWAP is unbiased over time and ACORN is not. Ultimately there are many reasons to expect that the raw data is not perfect. But there is no valid reason to suspect that biases will not centre on zero. For a start, each site would have a least two thermometers and probably four in each screen. For non-automated readings, immediately after the thermometers are reset the maximum, the minimum and the dry bulb thermometers should all read the same temperature. This gives a basic check and all the fancy algorithms and computer programs in the world cannot change the facts recorded in this raw data.

3. The third key difference is that ACORN data is homogenised on a daily base and WNAWAP has only been subject to basic quality control. The trouble for ACORN is that these adjustments are neither fully explained nor quantified and so far do not seem to be duplicable by anyone outside. It really seems too much to believe that temperatures around 1910 would have really all been consistently reading 0.5^{o}C too low.

GRAPHING the APOCALYPSE

On page 15 is the admission by the peer reviewers that, "***The ACORN analyses also show a larger amplitude of the residuals to the quadratic regression than the other two analysis sets."*** Normally larger residuals are associated with poorer fit. In this case the lowest residuals to the quadratic regression, and therefore greater predictive capacity, belonged to the WNAWAP. (see page 16 of report 3b.)

Quadratic and other polynomial equations always trend to infinity. That is what they do. Quadratic equations graph parabolas. They should not be used to graph cyclic phenomena such as weather or climate, because whilst they can be made to fit a short section of data of say 100 years, any extrapolation outside this will quickly lead to absurd results. Yet the BoM justifies their use with the following statement: ***" Much evidence has now been assembled in the scientific literature for an anthropogenic influence on global and Australian temperatures (Karoly and Braganza 2005; IPCC 2007). Based on these studies, physical evidence exists for a warming signal in Australian temperatures on multi-decadal timescales, as well as interannual and decadal variability."*** The quadratic equation fitted to ACORN TMax above predicts temperature rises of 1.5^{o}C over the next 50 years to 2060, an additional rise of 2.7^{o}C over the following 50 years to 2120, an extra 3.7^{o}C to 2160 and so on to infinity. The quadratic equation for TMin predicts even faster rises. Ultimately this is absurd; sometime around 2600 the sea will begin to boil. Where is any analysis of the nature of the interannual and decadal variability? This is also at odds with current theories of CO_2 enhanced warming that suggest a diminishing effect as CO_2 levels increase and an expectation of roughly linear rises. All this predicated on a restricted and spatially inhomogeneous dataset and on the basis of trend lines that are actually a poor fit to the actual data.

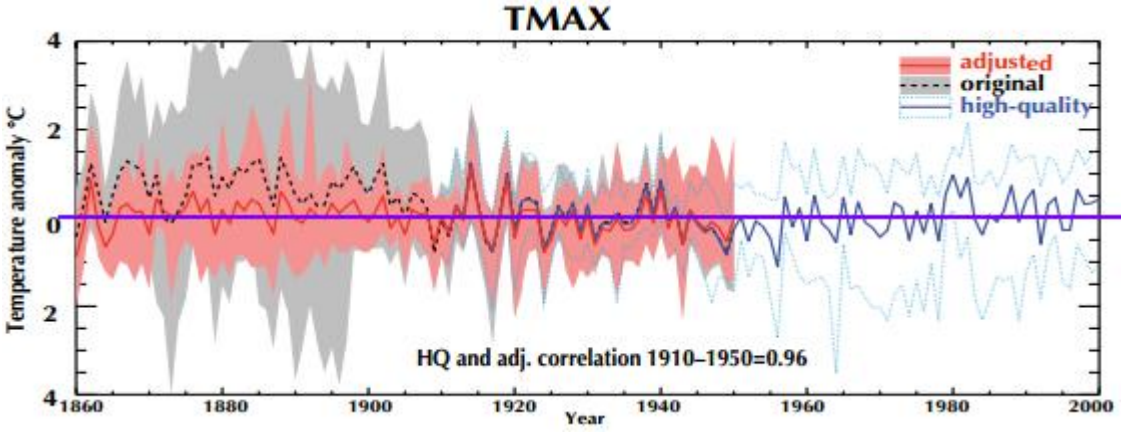
Further justification comes in the form that of all the possible trend lines that could be fitted quadratic trend lines gave the" ***smallest leave-one-out cross-validated root-mean-square errors (RSMEs) and mean absolute errors (MAEs) for a variety of polynomial (ordinary least squares regression) models".*** (see page 31). Leaving aside the craziness of even bothering to compute leave one out cubic, quartic or quintic regressions for ACORN, the difference between RSMEs for linear regressions at 0.332^{o}C and for a quadratic regression at 0.323^{o}C amounts to a whopping 0.009^{o}C or slightly less than 1/100th of a degree! For MAEs the difference is even less at 0.003^{o}C!

In reality if the climate has a cyclic element it cannot be modelled with poorly fitting trend lines of the types the BoM seems restricted to. The actual data as graphed by WNAWAP suggests a very different pattern to the one presented with ACORN. It suggests that temperatures were in fact dropping in the early part of the study. Other work, based on actual temperature recordings, indicate that they may well have been dropping from a peak in the late 1890s.

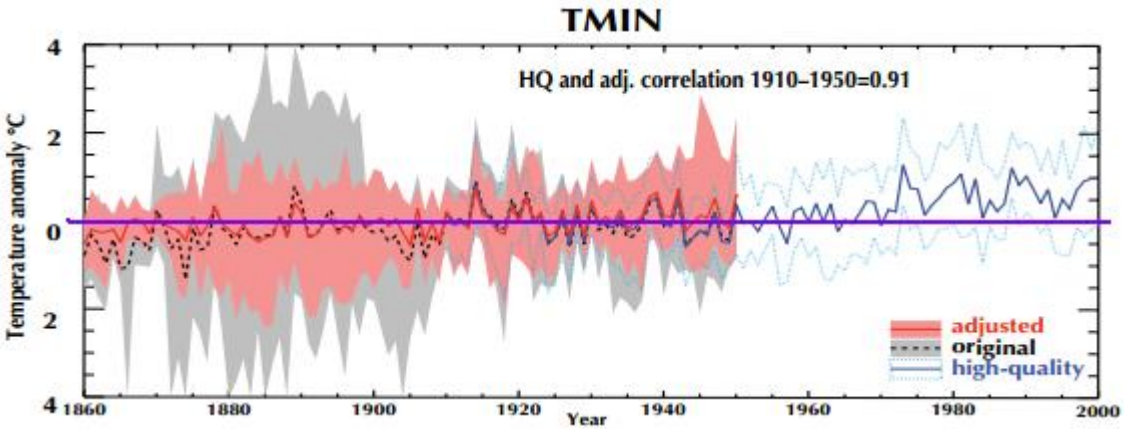
It is sad that these alternate interpretations are not being pursued by the BOM and CSIRO with the vigour they apply to the "message" as interpreted in ACORN. It is also inappropriate that the BOM and CSIRO no longer exercise the language of moderation when making prognostications for the future or when commenting on the recent past. ACORN-SAT is simply an experimental reconstruction of past temperatures. It is not authoritative in any meaningful sense.

An example of a very interesting, well-constructed and clearly explained attempt at a climate reconstruction is the paper "Temperature Reconstruction for SE Australia 1860-1890" (Linden Ashcroft, David Karoly and Joëlle Gergis of theSchool of Earth Sciences, University of Melbourne, Australia). For illustration I have copied two graphs from this paper. These are for maximum and minimum temperature anomalies (TMAX and TMIN) for the south east sector of the Australian continent. They cover a period back to 1860. These are important because they have all the elements that ACORN lacks. They show the original data, the adjusted data and the maximum and minimum anomalies for each in the data. Further the paper states clearly the methodologies used and clearly indicates that it is a reconstruction. **Note I have added a purple line to show the zero anomaly line.**

TMAX for South East Australia from Ashcroft et all…



TMIN for South East Australia from Ashcroft et all…



The original paper is www.wcrp-climate.org/conference2011/posters/C23/C23_Ashcroft_T180A.pdf

This paper does not cover the whole of Australia but even a cursory look should satisfy the view that it does not match the ACORN-SAT dataset at all well. For TMax in particular it seems to mimic the trends discussed above in the whole network datasets such as WNAWAP. Additionally it hints, if you follow the actual original data line as shown by the dashed line, to a sustained period of high temperatures in the years before 1910.

In conclusion I would like to reiterate that the ACORN-SAT dataset is simply one of many experimental datasets and on my reading of the available commentary not a particularly accurate one. It should be presented as such. Every effort must be made to avoid confusion. Entries should not have the names of existing stations. Everyone knows that Alice Springs Airport did not exist in 1910 but there it sits in ACORN complete with daily data. To be honest, ACORN must:

- Uses nomenclature that identify that the data is a construction;
- Show the original data source, its name and the original recorded data;
- Identify each adjustment and the reason for that adjustment;
- Be increased in size to as close as possible to the whole network; and
- Not be modelled using inappropriate trend lines.

Above all ACORN must not be used as the basis for unjustified press releases. The BOM must adopt a more measured approach, similar to that used in its forecasts. I won't detail these, but many of the announcements being made and constantly repeated in the press concerning future warming scenarios are now bordering on the ludicrous. If these are based on quadratic trendlines and predicated on an already biased and less than complete dataset then their usage borders on dishonest.

Yours sincerely

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