# ACORN-SAT - The Australian Bureau of Meteorology temperature database – is not to be trusted.

Ed Thurstan April 28, 2013

## Abstract

The second release of ACORN-SAT confirms my 2012 contention that the Australian Bureau of Meteorology this temperature database should be withdrawn. The gross arithmetical errors it displayed in 2012 that were generated by the BoM's data refining processes are still evident in the latest release. This indicates that the BoM either has not checked the product as stated, or they do not care that their errors are on public display.

Yet the BoM are using this database to support public statements about the climate, extreme temperature events and possible future trends.

### Background

In 2012 the Australian Bureau of Meteorology (BoM) released a new Temperature dataset, known as "ACORN\_SAT". It replaced the "High Quality" dataset, and the "Reference" dataset that were developed to emulate the NOAA administered US Climate Reference Network (USCRN). The USCRN consists of 114 purpose built surface weather stations designed to be protected from local effects that might introduce human induced temperature errors. It has only about 10 years of history. The BoM approach has been to establish a 100 year history from 112 stations by merging and homogenising station data using a variety of mathematical and statistical methods.

The ACORN-SAT database was announced in 2012 with much fanfare. At this site

http://www.bom.gov.au/climate/change/acorn-sat/

you will find statements like

"The ACORN-SAT dataset employs the latest analysis techniques......"

"The Bureau's climate data experts have carefully analysed the digitised data to create a consistent —or homogeneous—record of daily temperatures over the last 100 years."

"An extensive audit trail of data and metadata keeps track of corrections that may need to be applied. The data from each ACORN-SAT observing location is subject to ten different quality control checks."

"Additionally, the Bureau maintains multiple temperature datasets—analysed in different ways—to provide consistency check on the accuracy of temperature observations."

"For this reason, a carefully prepared dataset such as ACORN-SAT is vital for climate research."

"Climatologists carefully analyse records to find any evidence of spurious artefacts in the data, which introduce changes over time that are not related to climate variability."

"All of the Bureau's published scientific works are subject to the expert peer review process required for publication in scientific journals or technical reports. For ACORN-SAT, the Bureau has initiated an additional international peer review of its processes and methodologies. A panel of world-leading climate experts convened in Melbourne for a week in 2011 to examine the methods used to analyse the Bureau's temperature data. This included receiving submissions and presentations from the scientists developing ACORN-SAT, as well as an examination of all Bureau processes—from instrument to final product—to maintain a homogenised temperature record......"

An International Peer Review gave ACORN-SAT the "Gold Seal of Approval".

" 'The Panel is convinced that, as the world's first national-scale homogenised dataset of daily temperatures, the ACORN-SAT dataset will be of great national and international value. We encourage the Bureau to consider the dataset an important long-term national asset.' ACORN-SAT International Peer Review Panel Report, 2011"

Enormous emphasis is given to the quality and value of the ACORN-SAT. Unfortunately, this acclaim is not deserved.

## **Findings**

In July 2012 I published a note concerning the quality of the first release of ACORN-SAT data. It appeared in:

#### Jo Nova

http://joannenova.com.au/2012/07/boms-new-data-set-acorn-so-bad-it-should-be-withdrawn-954min-temps-larger-than-the-max/

#### **Andrew Bolt**

http://blogs.news.com.au/heraldsun/andrewbolt/index.php/heraldsun/comments/whats\_hot\_are\_t he\_boms\_figures/

#### **Quadrant Online**

John McLean discussed the same subject in the January 27, 2013 edition of Quadrant Online, although wrongly attributing my findings to Ken Stewart.

http://www.quadrant.org.au/blogs/doomed-planet/2013/01/our-hottest-week-ever/

The construction of the ACORN-SAT database and the tests applied to that data was described in the March 2012 BoM report

"Techniques involved in developing the Australian Climate Observations Reference Network – Surface Air Temperature (ACORN-SAT) dataset". CAWCR Technical Report No. 049 - Blair Trewin.

A comparative analysis of ACORN-SAT was reported in Report 3b for the Independent Peer Review of the ACORN-SAT data-set – "On the sensitivity of Australian temperature variability and trends to analysis methods and observation networks" – July 2011.

In my July 2012 note I described my attempt to repeat the checks described in CAWR Rept. 049. The first of those checks is that the Maximum for any reporting day should be >= the Minimum for that same day. The second was that in a 9am reporting regime, the Maximum on any day should be >= the Minimum for the following day.

I showed that the first release of ACORN-SAT data failed the former test 954 times. That might seem a small error percentage in several million records, but it highlights several issues:

- 1. The errors are trivial to discover, and should have been detected by the very first test described as having been performed in CAWR Report No. 049, Section 6.
- 2. More importantly, it is clear that the errors arose in the data merging/homogenisation processes described in CAWR Report No. 049. The errors are not evident in the "raw" BoM data.
- 3. Those merging/homogenisation procedures were generally applied to blocks of several years of data. It is absolutely reasonable to assume that all of those blocks of data are therefore suspect. That is, many years of ACORN-SAT are of dubious quality not just the 954.

I said in that report that ACORN-SAT should be withdrawn until these errors were corrected.

## 2<sup>nd</sup> Release of ACORN-SAT

The second release of ACORN-SAT was in January 2013, to Y/E Dec 31, 2012. My data was downloaded Jan 21, 2013.

I performed a detailed comparison between Releases 1 and 2. My findings follow. I give only single examples of these for brevity. A full log of the output of this comparator program is available from me as described at the end of this report.

#### **Results**

#### 1. All the Release 1 errors to Y/E Dec 2011 are repeated in Release 2.

That is, the 954 errors where Maximum is reported as less than Minimum on the same day, as found in the first release, persist in Release 2. For example:

086071 Melbourne Regional Office				
19110507	Max=14.9	Min=15.7		
19180515	Max=15.7	Min=16.3		
19200403	Max=16.2	Min=16.6		
19261217	Max=16.9	Min=17		
19290222	Max=20.6	Min=20.9		
19740515	Max=15.8	Min=16		
19920812	Max=11.3	Min=11.6		

2. The errors (in a 0900-0900 reporting regime) where today's maximum is reported as

less than tomorrow's minimum are repeated in Release 2.

For example:

009789 Esperance

192	81229 Ma	x=23.4	Min=15
192	81230 Ma	x=40.6	Min=23.8
192	90628 Ma	x=11.1	Min=9.3
192	90629 Ma	x=19.4	Min=11.3
193	30824 Ma	x=11.6	Min=10.3
193	30825 Ma	x=19.8	Min=14.6

3. There was missing data in some Release 1 series. I did not comment on it at the time because it was all at the end of 2011 data, and I thought the problem might be simply late delivery of data. But Release 2 appends a further year of data, and those missing dates are still there, now embedded in the series.

For example:

acom.sat.maxT.085096.daily.txt				
37248	20111223	19.4		
37249	20111224	21.2		
37250	20111225	20.9		
37251	20120101	99999.9		
37252	20120102	99999.9		

The published policy of the BoM is to make all date series contiguous, and that missing or questionable data is to be represented in these series as "99999.9"

Three stations in Western Australia end in August 2012. The ACORN-SAT Station Catalogue released in 2012 gave notice that

these three stations would be replaced in the ACORN-SAT dataset, some time in the future, the replacements being neighbouring stations. However, there are no new stations listed in the current Station Catalogue.

4. Every recorded temperature in the Release 1 dataset was compared with its matching one in the Release 2 dataset. There were no differences.

This suggests that no effort has been made to review the Release 1 product before appending 2012 data to form Release 2 database. It appears that the 2012 data is simply raw BoM data, with only rudimentary quality control checks applied.

## **Summary**

The BoM protestations about the expertise they have and the quality of their data are largely correct, I am sure. But the ACORN-SAT does not support that conviction.

- The product fails quality control checks that BoM say were performed.
- An expert peer review process failed to see those failures.
- The errors were highlighted in widely read blogs almost a year ago.
- The BoM has updated the database with 2012 data, without fixing those earlier errors implying that they have not yet detected those errors, or that they have ignored them.

My professional training says that such a product should not be trusted. I am aware that the BoM qualify most of their products with a disclaimer like:

"Information at this site:

.....

is subject to the uncertainties of

#### scientific and technical research

may not be accurate, current or complete ..... "

But a scientist cannot disclaim responsibility for making adjustments to temperature data that result in a large number of daily Maximums being less than Minimums for the same day while simultaneously stating that the data has been checked for such an errors. Their failure is compounded when these errors remain in the second release of the ACORN-SAT product, almost a year after the errors first became evident. Therefore ACORN-SAT cannot be trusted, and should be withdrawn.

## **Supplementary Information**

An Excel Log of all the results obtained to support this report is available on request from me. There are two sets of output.

- The output that logs the errors found in ACORN-SAT Release 1, covered in my 2012 report.
- The output that logs the comparison between Release 1 and Release 2 of ACORN-SAT.

All of the BoM documentation concerning ACORN-SAT is available through:

http://www.bom.gov.au/climate/change/acorn-sat/

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