



# Developments since 2011 Independent Peer Review of ACORN-SAT

This factsheet provides information on updates and improvements to the Australian Climate Observations Reference Network – Surface Air Temperature (ACORN-SAT) data and methods since 2011, including:

- ACORN-SAT network within the Bureau's Observation strategy
- new temperature data and pre-1910 data
- metadata for replication of analyses
- Independent Peer Review (IPR) recommendations
- scientific adoption of data and analyses.

## ACORN-SAT network

ACORN-SAT stations are given priority when programming maintenance and inspection visits. Stations are visited a minimum of once per year. Particular attention is paid to ensure stations are consistent over time and meteorologically representative of the local area.

From time to time, external factors dictate that a station must be moved, due to lease expiry or local development, or other factors outside of the Bureau's control. When this occurs, every effort is made to ensure that there is a minimum two-year overlap between the old and new station locations.

## New temperature data

The ACORN-SAT data is regularly updated, incorporating new data and newly digitised historical data, forced changes to the observing network and analysis improvements over time.

New (real-time) daily data have been added to the ACORN-SAT dataset since 2010 as they have been observed. As an example, ACORN-SAT data for the whole of 2014 was added in early 2015 providing for a complete summary of the prior year.

A new version of the ACORN-SAT dataset is planned for release later in 2015. This will include recently digitised historic daily data from three

locations (Moree, Sale and Canberra), extending those records back by 17 (Canberra), 36 (Sale) and 47 (Moree) years. It will also include assessment of, and where required, adjustments for, recent inhomogeneities at ACORN-SAT locations, as well as a reassessment of existing adjustments.

## Inclusion of pre-1910 data

While the national analysis of temperature begins in 1910, the Bureau of Meteorology also holds temperature data from earlier periods. There are two reasons why national analyses for temperature currently date back to 1910, which relate to the quality and availability of temperature data prior to this time.

1. Prior to 1910, there was no national network of temperature observations. Temperature records were being maintained around settlements, but there was very little data for Western Australia, Tasmania and much of central Australia. This makes it difficult to construct a national average temperature that is comparable with the more modern network.
2. The standardisation of instruments in many parts of the country did not occur until 1910, two years after the Bureau of Meteorology was formed. Standard instruments and practices were in place at most Queensland and South Australian sites by the mid-1890s, but in New South Wales and Victoria there were still many non-standard sites in place until 1906–1908. While it is possible to retrospectively adjust temperature readings taken with non-standard instrumentation, this task is much harder when the network has very sparse coverage and descriptions of recording practices are patchy. Further, the size of adjustments required to account for different practices can be very large, and in some cases cannot be done with confidence.

These factors create very large uncertainties when calculating national temperatures before 1910, and preclude the construction of nationwide temperature analyses (gridded over the Australian continent) on which the Bureau's annual temperature series is based.



At this point it is important to recognise that ACORN-SATs primary purpose is to provide reliable temperatures at representative and diverse locations. Subsequent analysis of these station data provide for a national gridded homogenised temperature dataset, and the average of these grids provides for areal averages (such as the Australian mean annual temperature). This process ensures that data are internally consistent. It requires both a good coverage of data and data which can be confidently adjusted to remove artificial and confounding changes.

The Bureau is interested in reconstructing regional temperatures from the colonial period. Recently, the Bureau collaborated with researchers from the University of Melbourne on the South Eastern Australian Recent Climate History (SEARCH) project. A dataset for the 1860–2009 period for southeast Australia was completed in 2013 by scientists at the University of Melbourne (Ashcroft et al., 2012). As this dataset is at the monthly timescale, and does not have national coverage, it is not directly comparable with ACORN-SAT in its current form. The Bureau is currently investigating how this dataset can be integrated with ACORN-SAT to allow reporting of post-1860 information for southeast Australia.

### Metadata for replication of analyses

The ACORN-SAT website now contains a great deal of information that is based upon extant metadata for historical observing sites, as well as relevant information that has been produced through the ACORN-SAT analyses.

An extensive site catalogue was developed and is readily available on the ACORN-SAT website:

[www.bom.gov.au/climate/data/acorn-sat/#tabs=Data-and-network](http://www.bom.gov.au/climate/data/acorn-sat/#tabs=Data-and-network)

This catalogue summarises the site history based upon the available metadata. A more extensive catalogue, including detailed discussion of each adjustment (along the lines of that presented for six of the 112 sites at:

[www.bom.gov.au/climate/data/acorn-sat/index.shtml#tabs=Adjustments&-network=](http://www.bom.gov.au/climate/data/acorn-sat/index.shtml#tabs=Adjustments&-network=)

is planned for release with the next version of the ACORN-SAT dataset later in 2015.

The supporting paper and electronic metadata for each location are extensive, including large volumes of routine correspondence. In some cases the material also requires considerable interpretation, especially where a change is

implied by an inconsistency between older and newer documents, rather than explicit (e.g. where a more recent document shows a site in a different location to an older document). A large allocation of resources would be required to extract potentially relevant documents and make them available in a form suitable for general public display across the network.

The material displayed on the Bureau website (<http://www.bom.gov.au/climate/data/acorn-sat/rutherglen/rutherglen-station.shtml>) for one specific adjustment at Rutherglen is an indication of the scale of effort which would be required to cover all adjustments.

### Progress with IPR recommendations

The current status of the Bureau of Meteorology response to recommendations of the ACORN-SAT Independent Peer Review Panel is reported in a separate document.

As at 25 February 2015, of the total of 31 recommendations of the Review, we have:

- Completed: 18
- In progress: 12
- Under review: 1.

### Scientific adoption

The ACORN-SAT data, and analyses based on those data, are being routinely used for a range of products and reports both nationally and internationally. They form the basis for routine reporting of Australian temperatures through the Bureau's Annual Climate Statements and other publications (e.g. [www.bom.gov.au/climate/annual\\_sum/annsum.shtml](http://www.bom.gov.au/climate/annual_sum/annsum.shtml)), and also form the basis for the reporting of observed trends in Australian temperature means and extremes in the joint Bureau/CSIRO State of the Climate Reports in 2012 ([csiro.au/Outcomes/Climate/Understanding/State-of-the-Climate-2012.aspx](http://csiro.au/Outcomes/Climate/Understanding/State-of-the-Climate-2012.aspx)) and 2014 ([www.bom.gov.au/state-of-the-climate/](http://www.bom.gov.au/state-of-the-climate/)).

The ACORN-SAT data have recently been incorporated into the University of East Anglia Climatic Research Unit (CRU)'s global temperature analyses, which form the land component of the HadCRU dataset (joint with the UK Meteorological Office's Hadley Centre), one of the three major datasets used for global climate monitoring (Morice et al., 2012). We note that the Bureau of Meteorology raw temperature data is also made



available to the international community and incorporated into a range of datasets reported by the World Meteorological Organization; most notably through the US National Oceanic and Atmospheric Administration and NASA Goddard Institute for Space Studies

Trewin (2013) describes the ACORN-SAT dataset and has been cited by more than 20 other science papers since its publication. These citations relate both to the methods used in developing the dataset and to the data themselves.

The Bureau continues to closely monitor developments in the international scientific arena relevant to long-term datasets. This includes the development and benchmarking of homogenisation methods (e.g. Venema et al., 2012), and the development of new datasets (e.g. Morice et al., 2012; Rohde et al., 2013).

### References

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