

ACORN-SAT version 1 station adjustment summary—Deniliquin (as at 24 September 2014)

Deniliquin is one of 112 ACORN-SAT stations used by the Bureau of Meteorology to assess changes in Australia's climate. The official long-term temperature record for Deniliquin is defined by the Bureau as a combination of the old 'town' station (station number 74128) and the automatic weather station (AWS) at the airport (station number 74258).

Observations at Deniliquin began in the 1850s, but early data were taken with non-standard instrument shelters and only post-1910 data have been included in the ACORN-SAT dataset. Comparison of the Deniliquin data with surrounding stations (neighbours), 26 of which have been used at various times, combined with the use of documentary records, reveals that there have been six significant breaks in the data. Three of these are associated with documented site moves, and a fourth is associated with building around the site. The raw data series is a combination of several data series that must be adjusted to derive a single, consistent and accurate representation of temperature changes over time.

The ACORN-SAT record contains daily records of minimum (night-time) temperature (Min T) and maximum (daytime) temperature (Max T). The charts in this fact sheet show annual average values of Min T and Max T. The impacts of the daily adjustments on the annual average values are shown in the table below.

The changes that occurred at Deniliquin and the resulting impacts are summarised as follows:

- 1 January 1943—breakpoint detected by statistical methods.
 - Daytime temperatures started to appear cooler relative to surrounding stations.
 - Max T adjusted by -0.37 °C. No detectable impact on Min T so no adjustments made.
- 1 January 1950—station documents indicate building around the site around this time.
 - Daytime temperatures started to appear warmer relative to surrounding stations.
 - Max T adjusted by $+0.51$ °C. No detectable impact on Min T so no adjustments made.
- 1 January 1960—breakpoint detected by statistical methods.
 - Daytime temperatures started to appear cooler relative to surrounding stations.
 - Max T adjusted by -0.51 °C (reversing the 1950 change). No detectable impact on Min T so no adjustments made.

- 13 August 1971—site move 1 km to CSIRO facility, outside town centre area.
 - Night-time temperatures started to appear much cooler relative to surrounding stations. Daytime temperatures also slightly cooler, especially in spring and summer.
 - Min T adjusted by -1.00 °C. Max T adjusted by -0.17 °C on an annual basis, with larger adjustments in spring and summer.
- 27 September 1984—site move 3.7 km to airport, south of town.
 - Daytime temperatures started to appear warmer in summer, and cooler in winter relative to surrounding stations.
 - Max T adjusted by $+0.37$ °C in summer and -0.38 °C in winter. No detectable impact on Min T so no adjustments made.
- 3 June 1997—AWS installed at airport, with manual site continuing at old location until 2003.
 - Night-time temperatures at AWS cooler than those at manual site.
 - Min T adjusted by -0.50 °C. No detectable impact on Max T so no adjustments made.

Charts 1 and 2 compare raw and adjusted data for annual average Min T and Max T when all relevant factors from 1910 onwards are included.

In Chart 1 the trend lines show the raw data trend for Min T is decreasing whereas the adjusted data trend is increasing. In this case, the adjustment has corrected the apparent, artificial cooling trend and now shows the warming trend.

In Chart 2 the trend lines show that the average Max T is increasing in both the adjusted and raw data, but the trend in the adjusted data is stronger than that in the raw data. In this case, the adjustment has increased the artificially small warming trend indicated by the raw data.

Chart 3 shows a comparison of minimum temperatures at Kerang (95 km west of Deniliquin) and Deniliquin in the years around 1971. Deniliquin is consistently warmer than Kerang prior to 1971, with similar or cooler temperatures after 1971. This, combined with similar results when Deniliquin's data are compared with other sites in the region, provides a very clear demonstration of the need to adjust the temperature data.

Chart 1: Deniliquin annual average minimum temperatures (1910–2013)

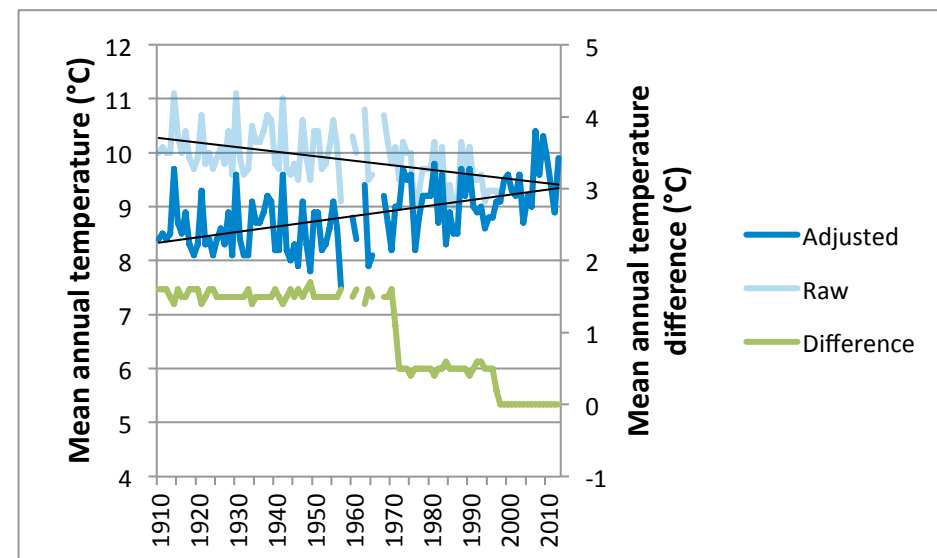


Chart 2: Deniliquin annual average maximum temperatures (1910–2013)

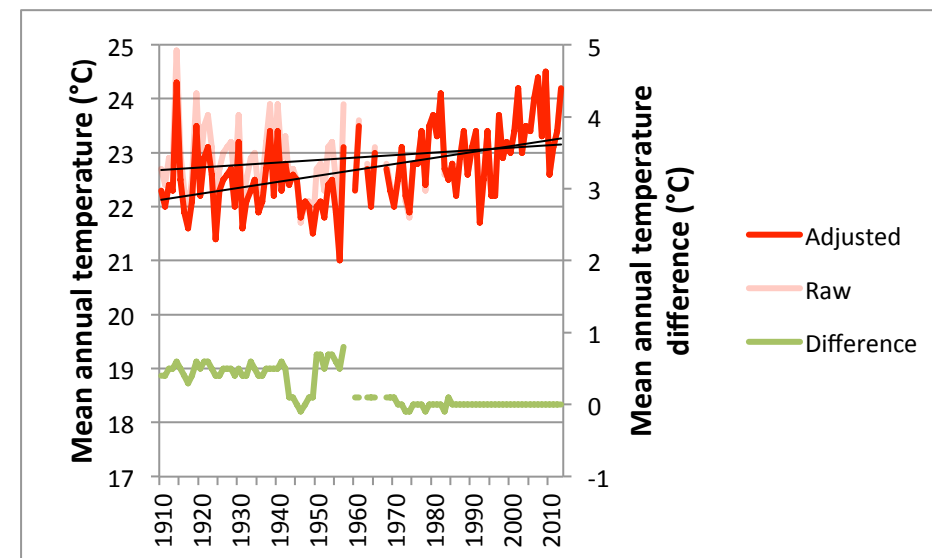
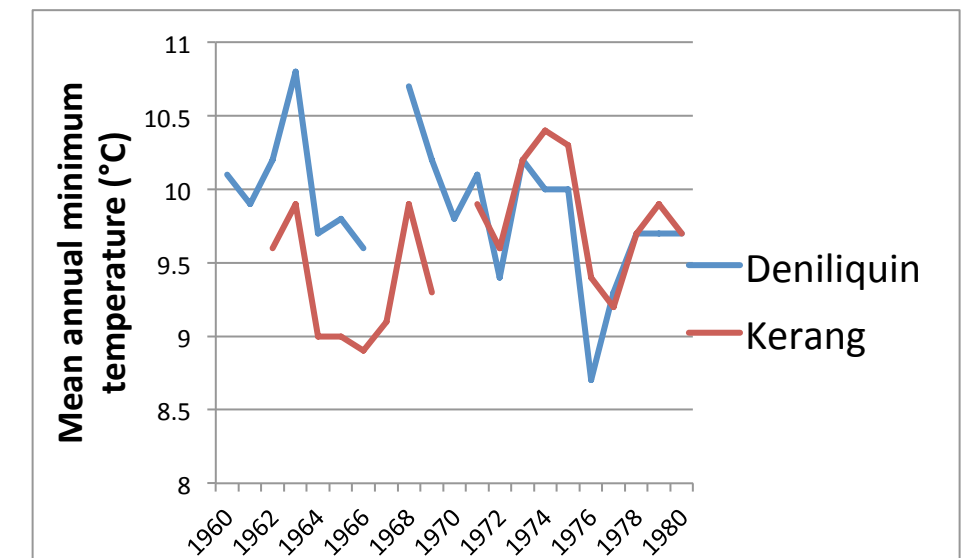


Chart 3: Comparison between Deniliquin and Kerang



Deniliquin station temperature adjustments

Station name	Station number	Temperatures adjusted	Date (adjustment applied to all data prior to this date)	Cause	Impact of adjustment (°C)	Seasonal (if applicable)	Comparative stations										Merged stations	Notes	
Deniliquin	74258	Min	3/6/1997	Move (with overlap)	-0.50													74128	
Deniliquin	74258	Max	27/9/1984	Move	0.02	Summer 0.37; winter -0.38	74106	80015	80023	80091	81084	75031	77042	81049	74034	81003			
Deniliquin	74258	Min	13/8/1971	Move	-1.00		80015	80023	74039	80043	80049	75031	77042	74009	80091	81084			
Deniliquin	74258	Max	13/8/1971	Move	-0.17	Spring -0.30; summer -0.37	74039	80015	80043	80023	80091	81084	74009	75031	77042	80049			
Deniliquin	74258	Max	1/1/1960	Statistical	-0.51		74069	74039	80015	80023	75031	77042	81003	82002	76031	82053			
Deniliquin	74258	Max	1/1/1950	Site environment	0.51		80023	77042	81003	76031	72150	47007	89002	78031	82039	47019			
Deniliquin	74258	Max	1/1/1943	Statistical	-0.37		80023	77042	81003	76077	72151	47007	89002	78031	82039	47019			

Comparative and merged stations

Station number	Station name
47007	Broken Hill (Patton Street)
47019	Menindee
72150	Wagga Wagga Airport
72151	Wagga Wagga
74009	Berrigan
74034	Corowa
74039	Deniliquin (Falkiner Memorial)
74069	Mathoura State Forest
74106	Tocumwal
74128	Deniliquin (Wilkinson Street)
75031	Hay
76031	Mildura Airport
76077	Mildura
77042	Swan Hill
78031	Nhill
80015	Echuca
80023	Kerang
80043	Numurkah
80049	Rochester
80091	Kyabram
81003	Bendigo
81049	Tatura
81084	Lemnos
82002	Benalla
82039	Rutherglen
82053	Wangaratta Post Office
89002	Ballarat

Station temperature adjustment table legend

- Station name: name used in the national climate record
- Station number: the active ACORN-SAT station number as at 31 December 2011.
- Temperatures adjusted: this describes which aspect of the temperature record was adjusted—Max for daily maximum temperature; Min for daily minimum temperature.
- Date: all data prior to this date was adjusted for the reason (cause) cited.
- Cause: this describes why an adjustment was required.
 - Merge: data from two different station numbers are being merged, with overlap.
 - Move: a documented site move.
 - Move (n): a documented site move, together with a change of station number.
 - Screen: indicates a change or repair to the Stevenson screen.
 - Obs time: indicates a change in observation time (most often the 1964 change at some stations from a midnight to 9 am observation time).
 - Site env: a change has occurred in the local site environment (e.g. addition/removal of building nearby, change in vegetation).
 - Statistical: a change found by statistical methods without specific documentary support.
 - Statistical*: indicates some kind of documentary support which may be imprecise or subject to interpretation. This is further explained in the notes field.
 - AWS: installation of an automatic weather station; if there was an associated site move this is shown as 'move'
- Impact of adjustment: the overall impact of the daily adjustments made for the particular reason (cause) cited.
- Seasonal (if applicable): this applies where the adjustment was made on the basis of seasonal, rather than annual, criteria. In general the minimum threshold for adjustment is a 0.3 °C difference in the annual mean. Exceptions include:
 - where seasonal criteria are met (0.3 °C in two seasons, or 0.5 °C in a single season), in which case details are given; or
 - for the 1964 observation time change, which standardised the time for taking all observations at 9.00 am.
- Comparative stations: stations against which the station's data was compared statistically.
- Merged stations: stations from which data was sourced and merged to enable adjustment (see Notes above).
- Notes: provides additional explanatory information.