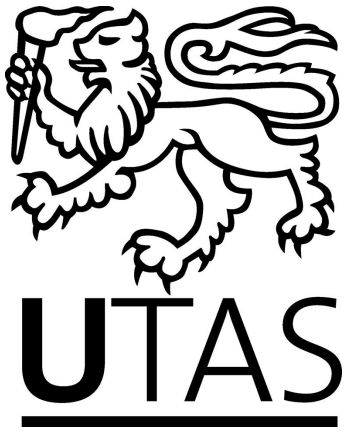

Analysis of historical temperature data of Victoria

J.D. Vlok

University of Tasmania
School of Engineering
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http://eprints.utas.edu.au/23461/
jdvlok@utas.edu.au

Abstract

Raw temperature data collected and made available online by the Australian Bureau of Meteorology are analysed in this report. The monthly mean maximum and minimum temperature series available for the state of Victoria are studied and historical temperature patterns from 1910 – 2016 are presented. It is shown that a high degree of synchrony exists between the temperature measurements across the state, including both the maximum and minimum temperature series. An average temperature trend for Victoria is also calculated by simply combining all the available raw measurements, and comparisons are made with other temperature series, including the ACORN-SAT record. This report forms part of a larger study where the aim is to reconstruct historical temperature trends for any given area where sufficient raw temperature data are available.

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Acronyms

ACORN-SAT	Australian climate observations reference network - surface air temperature
BOM	bureau of meteorology
CDO	climate data online
LS	least squares
MA	moving average
PDF	probability density function
SE	South-East

1 Introduction

The Australian bureau of meteorology (BOM) employs a vast network of sensors across the continent to measure a number of weather parameters. Over the last 160 years, a total of nearly 1900 weather stations have contributed to the historical Australian weather record which is publicly available at the online BOM archive [1]. The weather station network has however continuously changed over its history as old stations were closed or moved and new ones were opened. Human activity has also influenced measurements as landscapes have changed, cities expanded, and measuring equipment and standards were updated.

Different approaches are followed to reconstruct historical weather records in an attempt to understand climate patterns, to evaluate the effect of human activity, and to make predictions. The study presented here focuses on the raw BOM climate data online (CDO) temperature record for the state of Victoria. Monthly mean temperature records available from the online archive are used here to analyse trends and patterns without performing any interpolation or changes to the raw data. Some comparison to other records, including the Australian climate observations reference network - surface air temperature (ACORN-SAT) dataset are also made.

CDO temperature records originating from a total of 290 weather stations are available for the state of Victoria. However, by evaluating the total number of measurements available over time, it seems that less than half of these stations have ever been active concurrently. Fig. 1 shows the locations of these stations, according to the BOM CDO archive [1]. Eleven of these stations also form part of the ACORN-SAT network, with their name places provided on the map. The location of each station is color-coded according to the average monthly mean maximum temperature value $T_{\max}$ calculated using the available CDO data between 1910 and 2016.

The information given in Fig. 1 is again illustrated in Fig. 2 using a probability density function (PDF). The average monthly mean maximum temperature recorded by the CDO weather stations between 1910 – 2016 is 19.3°C. The temperatures are mostly concentrated around the average value as shown, with a few outliers including the coldest stations located on the Eastern Highlands.

The average CDO values of the 11 ACORN-SAT stations are also indicated in Fig. 2. These stations cover the main probability mass, while ignoring the few outlying regions. The average of these 11 stations is 20.1°C, close to 19.3°C - the overall CDO average.

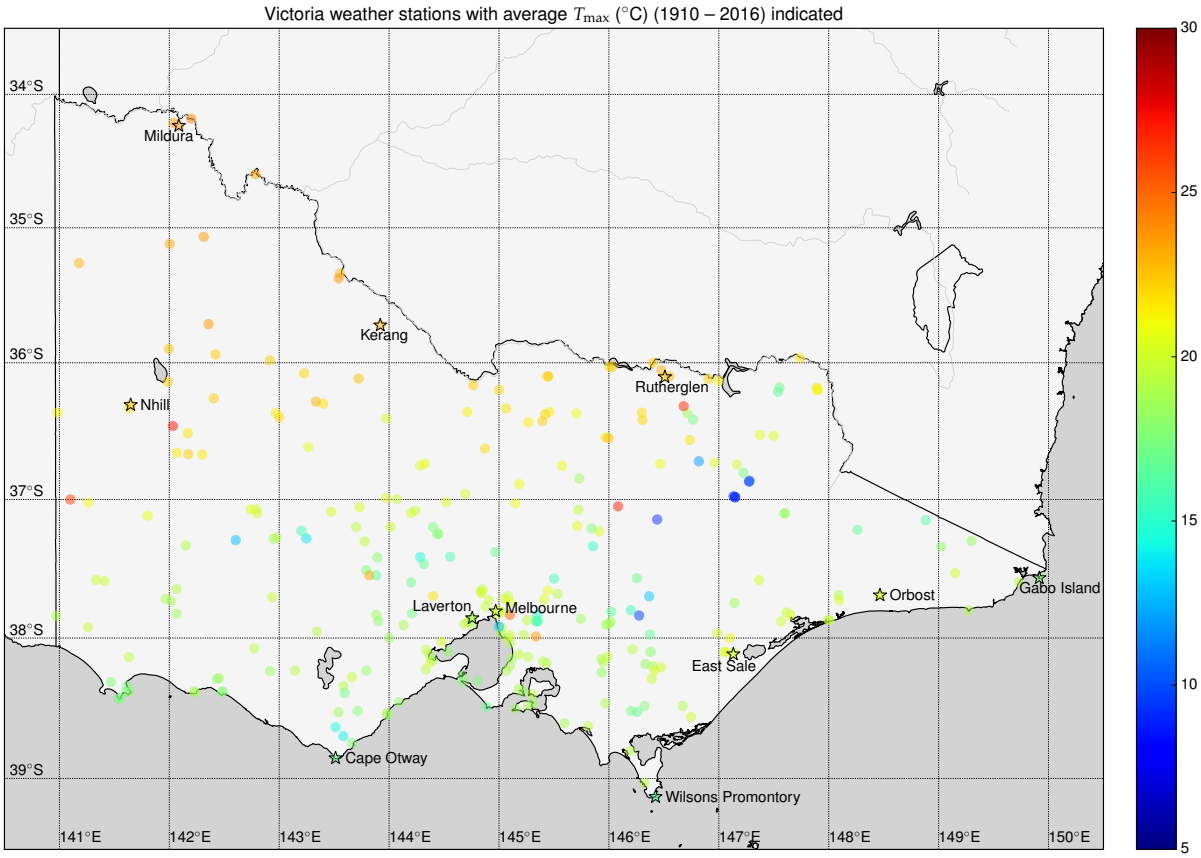

Figure 1: CDO weather stations in Victoria, with ACORN-SAT station names indicated. Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/

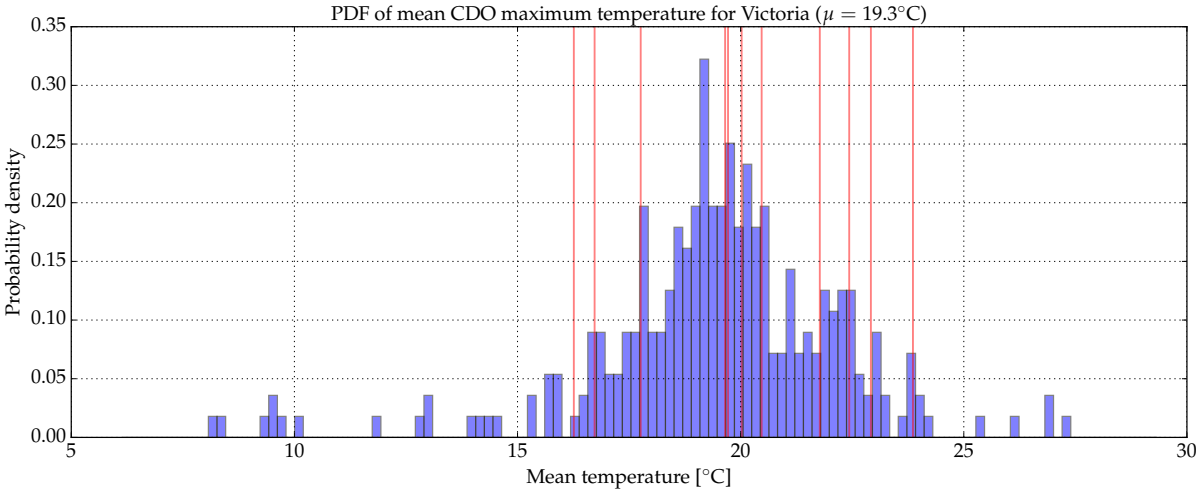

Figure 2: Probability density function of Victorian mean maximum temperature during 1910 – 2016. The red lines indicate the mean of each of the 11 ACORN-SAT weather stations. Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/

2 Methodology

To analyse long-term temperature trends of a given location, or to compare two or more different weather stations, the following two series are considered in this study.

- The twelve-month moving average (MA) which is a series of monthly values, where the value for any given month represents the average temperature of the past twelve months (including the given month). Note that no attempt is made in this study to interpolate missing data; the MA sequence will therefore only have a value for a given month if the preceding twelve months have data values available.
- The annual average which is a series of average temperature values calculated over calender years. This series can therefore be derived from the MA sequence simply by concatenating the MA values corresponding to every December month.

The following data available at the BOM online archive were used in the analysis.

- CDO monthly mean maximum temperature data of 289 weather stations listed in [2].
- CDO monthly mean minimum temperature data of 290 weather stations[1] listed in [3].
- The maximum annual anomaly temperature ACORN-SAT data of the Victoria stations available at [4]. The actual temperature series is calculated from the anomaly data simply by adding the published average value given for the period 1961 – 1990.
- The daily maximum and minimum ACORN-SAT temperature data of the Victoria stations available at [5].

Calculation of the twelve-month MA for an individual station from monthly data is illustrated in Fig. 3 where the Rutherglen Research station is considered. As each CDO dataset includes one value for each month, the minimum and maximum monthly mean temperature series exhibit a clear sinusoidal pattern with one cycle per year corresponding to seasonal variability. Long-term variability becomes more apparent through the use of the twelve-month MA also shown in the figure for each monthly mean series.

[1] Cape Patton (90137) only has monthly mean minimum temperature data available. The other 289 station records include both minimum and maximum values.

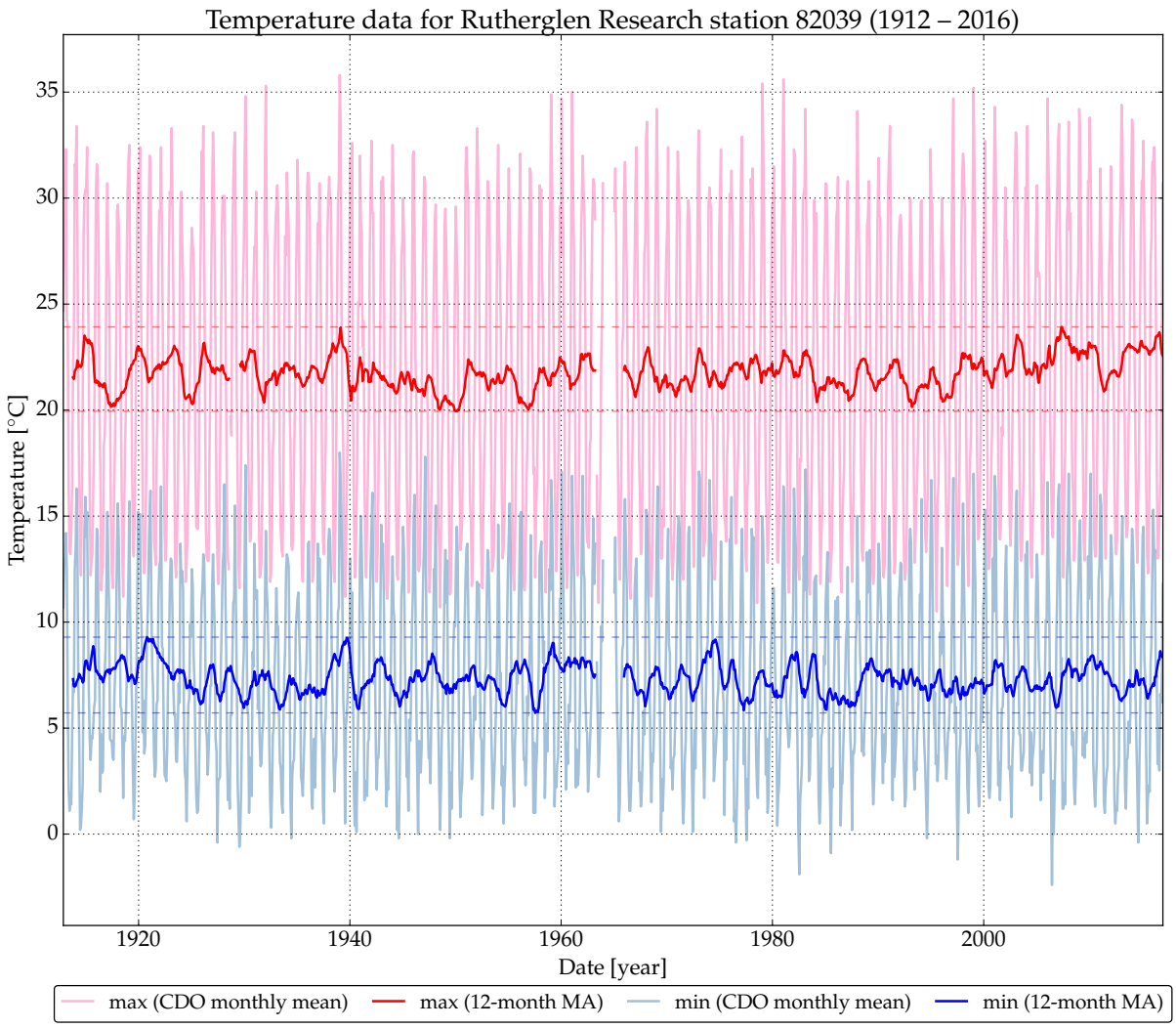

Figure 3: Monthly mean data with twelve-month moving average for the Rutherglen Research station.

Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/

3 Monthly mean temperature series

3.1 Mean maximum temperature series

The twelve-month MA temperature series of all weather stations in Victoria measuring mean maximum air temperature are displayed in Fig. 4a. Each MA series is calculated from the CDO mean maximum temperature record as discussed in Section 2. The mean of all available data of individual MA series is also shown in Fig. 4a (in black).

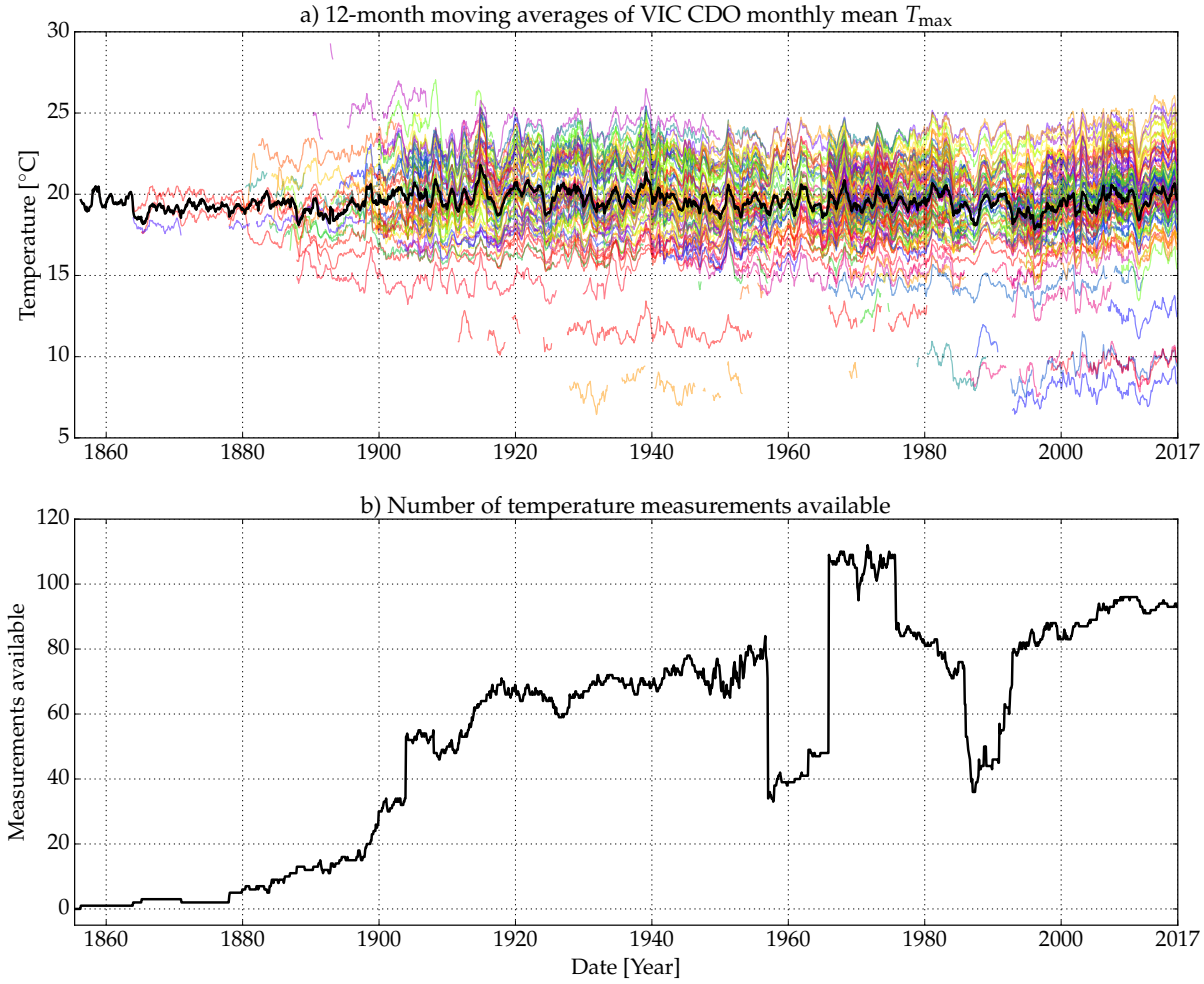

Figure 4: Moving average of all VIC CDO mean maximum temperature records.
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/

Fig. 4b shows the number of temperature samples available over time, which corresponds clearly to Fig. 4a in terms of the number of individual temperature graphs shown. In terms of estimating the true Victorian average temperature, it can be expected that accuracy will increase with the number of measurements available. Fig. 4b can therefore be used to indicate relative confidence of the mean temperature series displayed in Fig. 4a.

To illustrate the strong synchrony between the maximum temperature records across all Victorian stations more clearly, the temperature graphs of Fig. 4a are displayed again in Figs. 5 to 7, by zooming in on different time periods. Although data before 1910 also show correlation between stations, it is omitted here as non-standard shelters were used by a number of Australian weather stations before 1910. Pre-1910 data may however still be useful, and could possibly be investigated in a future study.

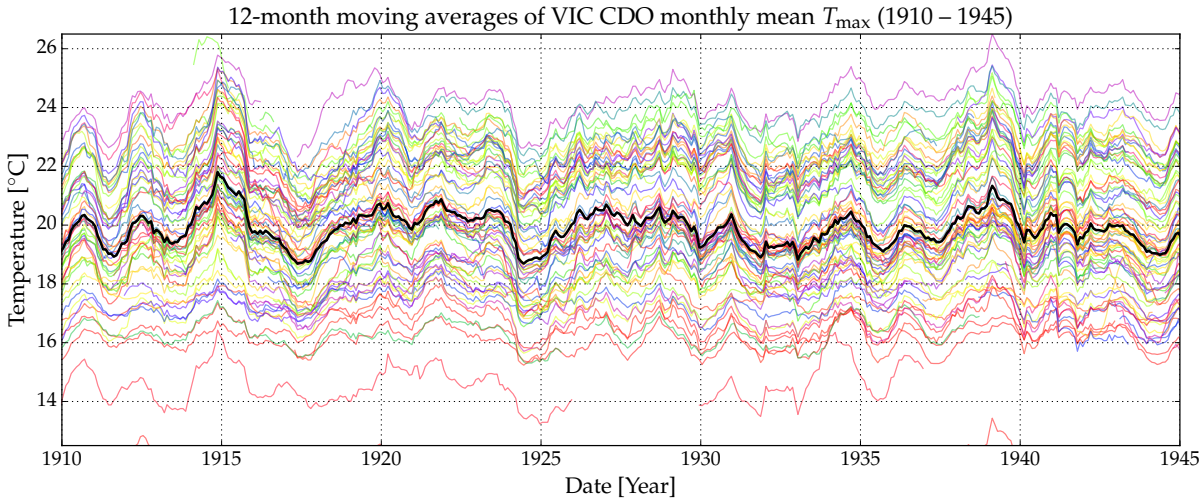

Figure 5: Moving average of all VIC CDO mean maximum temperature records (1910–1945). Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/

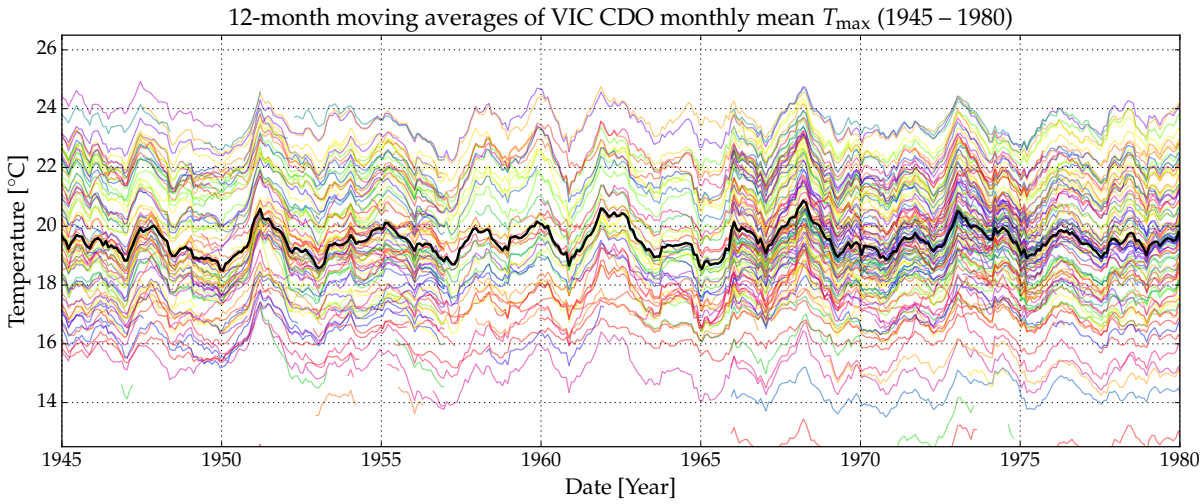

Figure 6: Moving average of all VIC CDO mean maximum temperature records (1945–1980). Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/

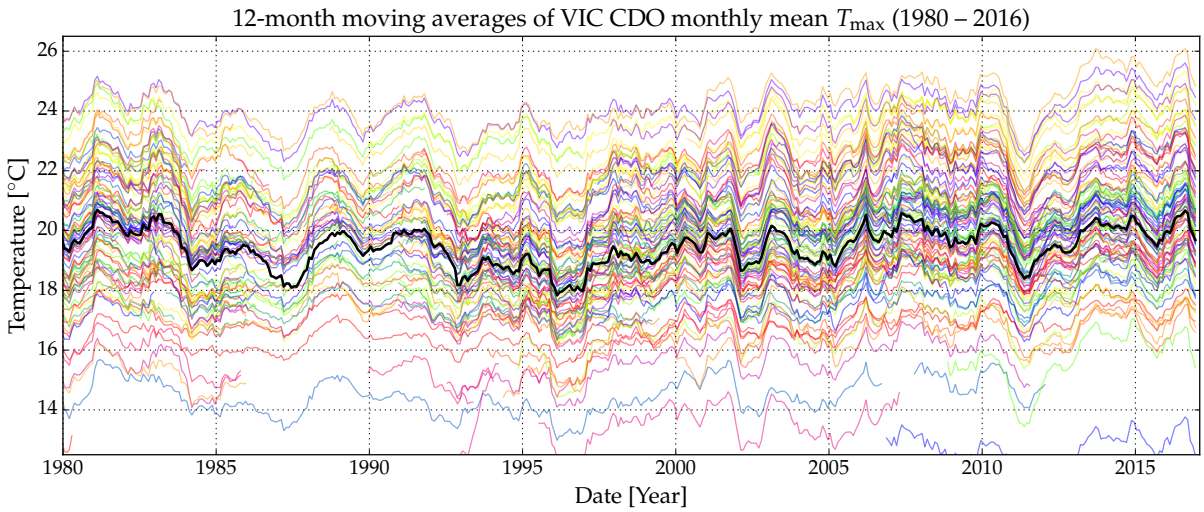

Figure 7: Moving average of all VIC CDO mean maximum temperature records (1980–2016).
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/

3.2 Mean minimum temperature series

Fig. 8 shows the same results for the mean minimum monthly temperature records that Fig. 4 showed for the maximum records. Figs. 9 to 11 also show the zoomed-in graphs displayed in Fig. 8 as was done for the maximum temperature records in Figs. 5 to 7. The minimum temperature series also exhibit a degree of synchrony, although it seems that more stations deviate from the overall pattern compared with the maximum temperature series.

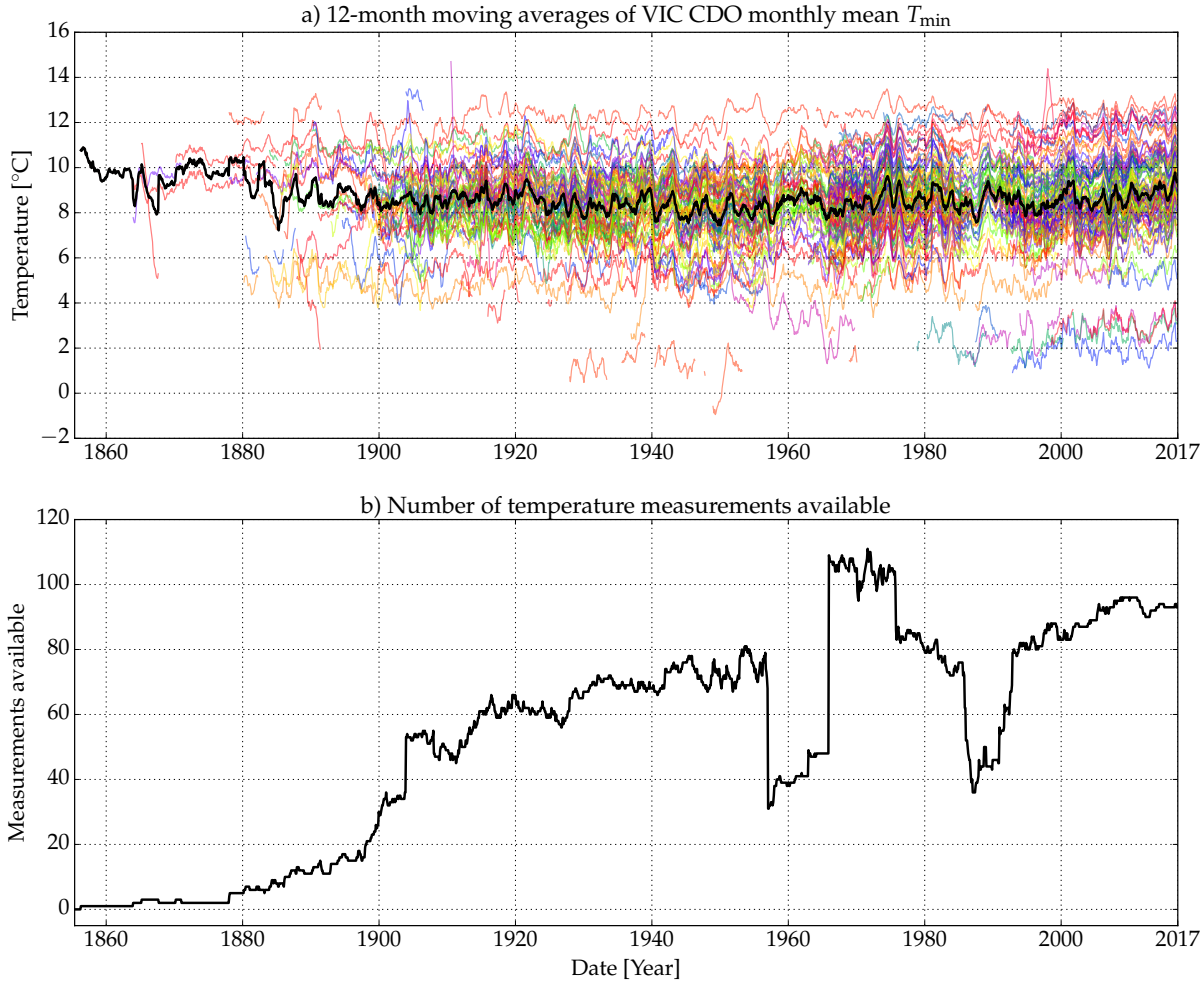

Figure 8: Moving average of all VIC CDO mean minimum temperature records.
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/

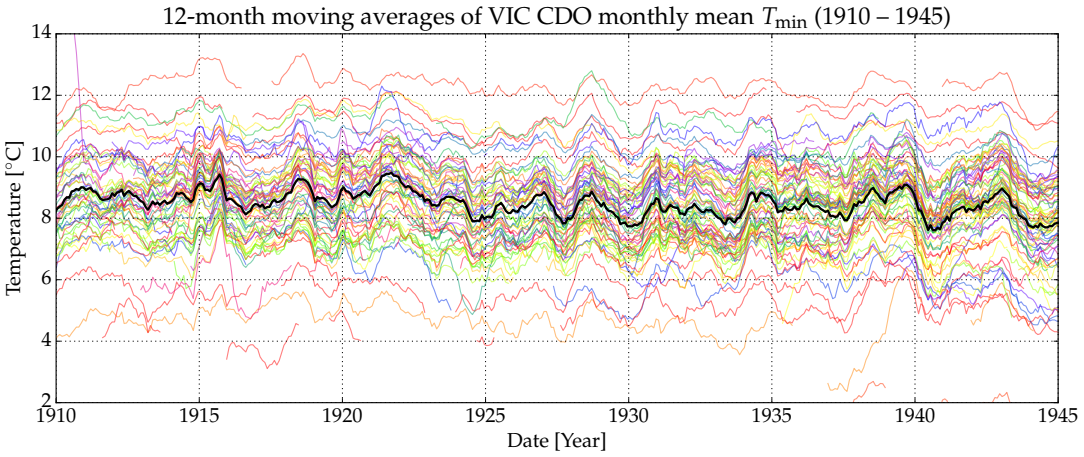

Figure 9: Moving average of all VIC CDO mean minimum temperature records (1910–1945).
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/

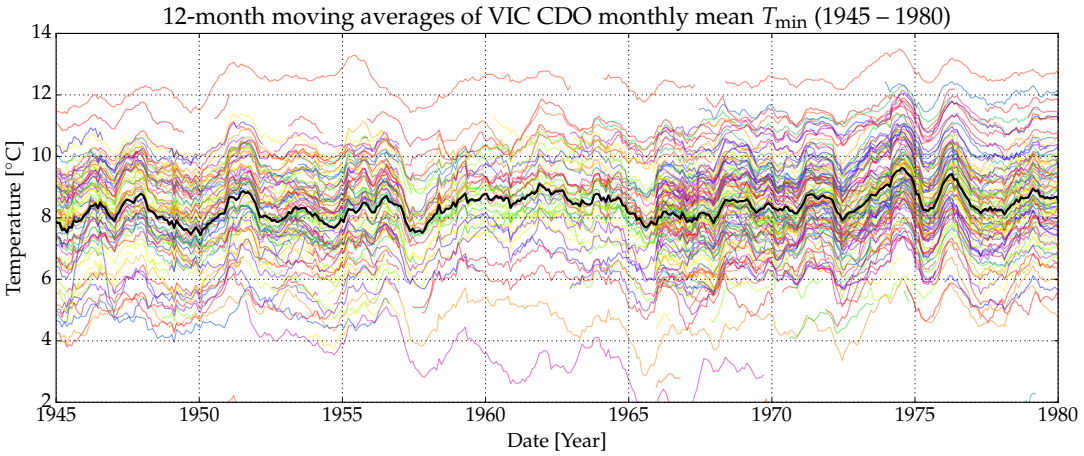

Figure 10: Moving average of all VIC CDO mean minimum temperature records (1945–1980).
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/

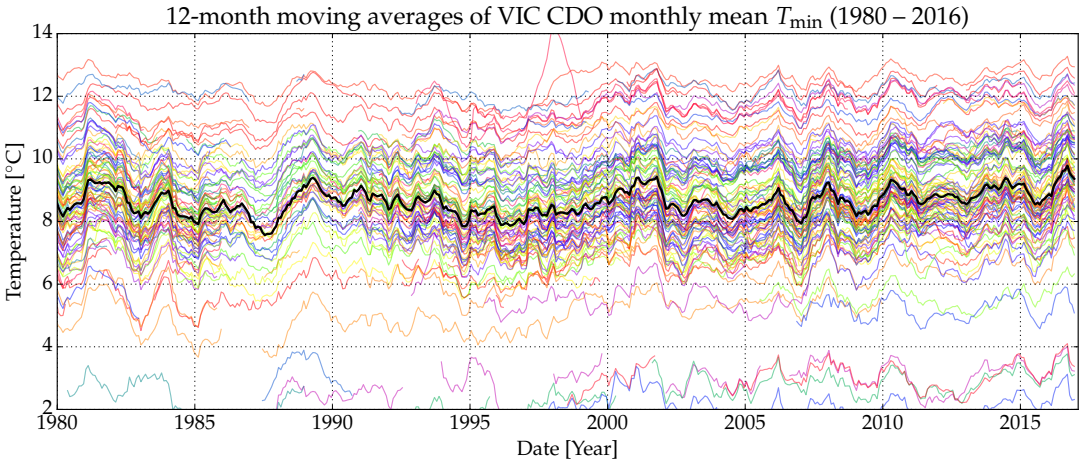

Figure 11: Moving average of all VIC CDO mean minimum temperature records (1980–2016).
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/

4 Comparison between different datasets

The annual average maximum temperature series computed from the 289 monthly mean maximum CDO records (as discussed in Section 2) and the ACORN-SAT data obtained from [4] for the state of Victoria are shown in Fig. 12 in blue and red respectively. Two other series, including a reconstruction of South-East (SE) Australia [6] and an interpolated Rutherglen series (using the raw CDO data) are shown in Fig. 12 for comparison.

Least squares (LS) regression lines with their slope values m are also shown in Fig. 12. Starting from 1910, the Rutherglen series indicate warming of approximately 0.5°C per century, while the ACORN-SAT data suggests warming of 1°C per century. Using all CDO data indicates cooling at a rate of 0.5°C per century. Note that these slope values are sensitive to starting and ending years; by calculating the slope for the CDO data over the whole range displayed in Fig. 4 (that is 1855–2016), slight warming at a rate of 0.028°C per century is obtained.

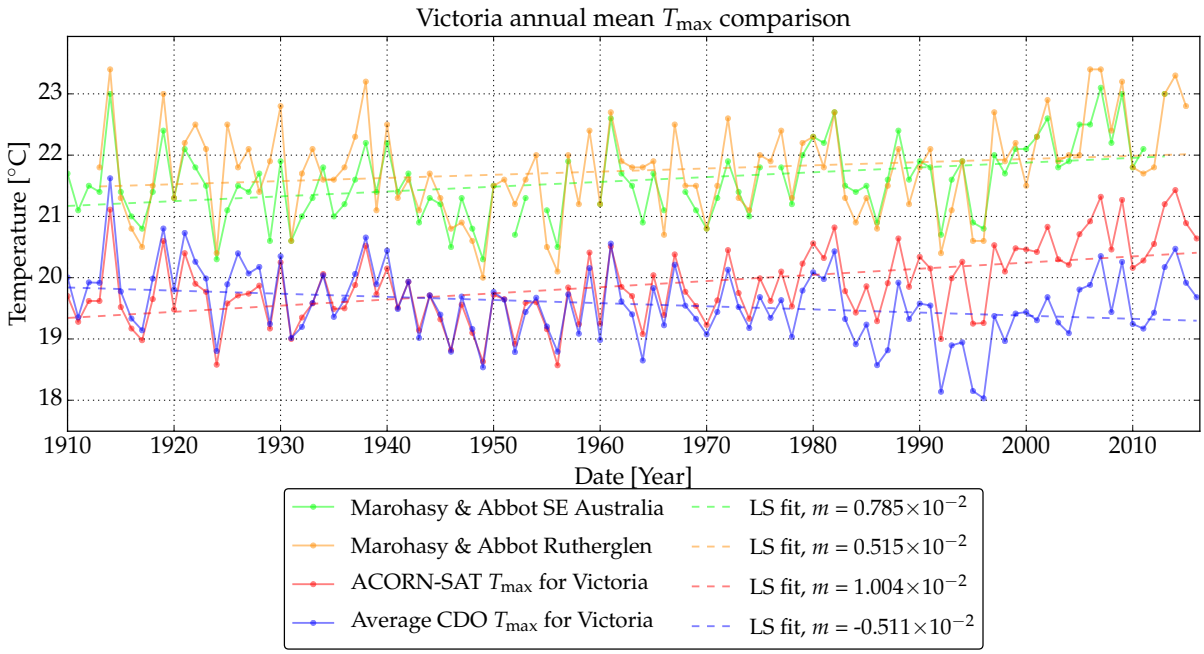

Figure 12: Comparison of Victoria and South-East Australia annual temperature trends. Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

The four temperature reconstructions in Fig. 12 show a high degree of synchrony, although they are based on different methods. The SE and Rutherglen series show a close match and are clearly hotter than the other two series (Rutherglen is clearly located in a warmer region of Victoria as Fig. 1 suggests). The CDO and ACORN-SAT series show a very

good match for the first half of the record. For the second half, the ACORN-SAT series shows a significant temperature increase compared with the CDO series. The deviation between the ACORN-SAT and CDO datasets is subsequently discussed further.

4.1 Comparison between ACORN-SAT and two CDO datasets

Comparisons between the ACORN-SAT and two different CDO mean temperature series are shown in the following sub figures:

- Fig. 13a which displays the annual average series computed from 16 CDO datasets contributing to the ACORN-SAT network (see Appendix A for details on these 16 stations).
- Fig. 13b which displays the annual average series computed from all 290 CDO data records available for Victoria.

The ACORN-SAT data displayed in Fig. 13 (identical in both sub-figures a and b) include the following.

- T_{max}, T_{min} and T_{mean} which are the BOM-published ACORN-SAT annual mean maximum, minimum and mean averages. Each average trend is calculated as the sum of the anomaly time series (annual mean temperature) plus average value available at [4]. The published average values are 19.9 (maximum), 8.3 (minimum) and 14.1 (mean) degrees Celsius, where 1961–1990 was used as the reference time period.
- The raw ACORN-SAT annual averages, which were derived from the daily temperature data available at [5]. Each annual average value is the average of twelve calendar monthly values, where each monthly value is the average daily temperature calculated over a calendar month.[2]

Except for the BOM-published mean trend ACORN-SAT T_{mean}, each mean trend shown in Fig. 13 was simply calculated as the average of the associated maximum and minimum trends shown.[3]

[2] An alternative method - resulting in slightly different values - is to calculate the annual average as the average of daily values over a calendar year. The difference between the two methods is the weighting assigned to each daily value, e.g. any daily temperature measurement in February 2016 contributes either a fraction of $(1/29)/12 \approx 2.874 \times 10^{-3}$ (first method) or $1/366 \approx 2.732 \times 10^{-3}$ (alternative method) to the annual average. Other factors such as thermometer accuracy should also be considered when evaluating these differences further.

[3] The difference between the ACORN-SAT T_{mean} and $(T_{\text{max}} + T_{\text{min}})/2$ is however insignificant on an annual scale - the maximum difference between any two points over the entire history is 0.015°C.

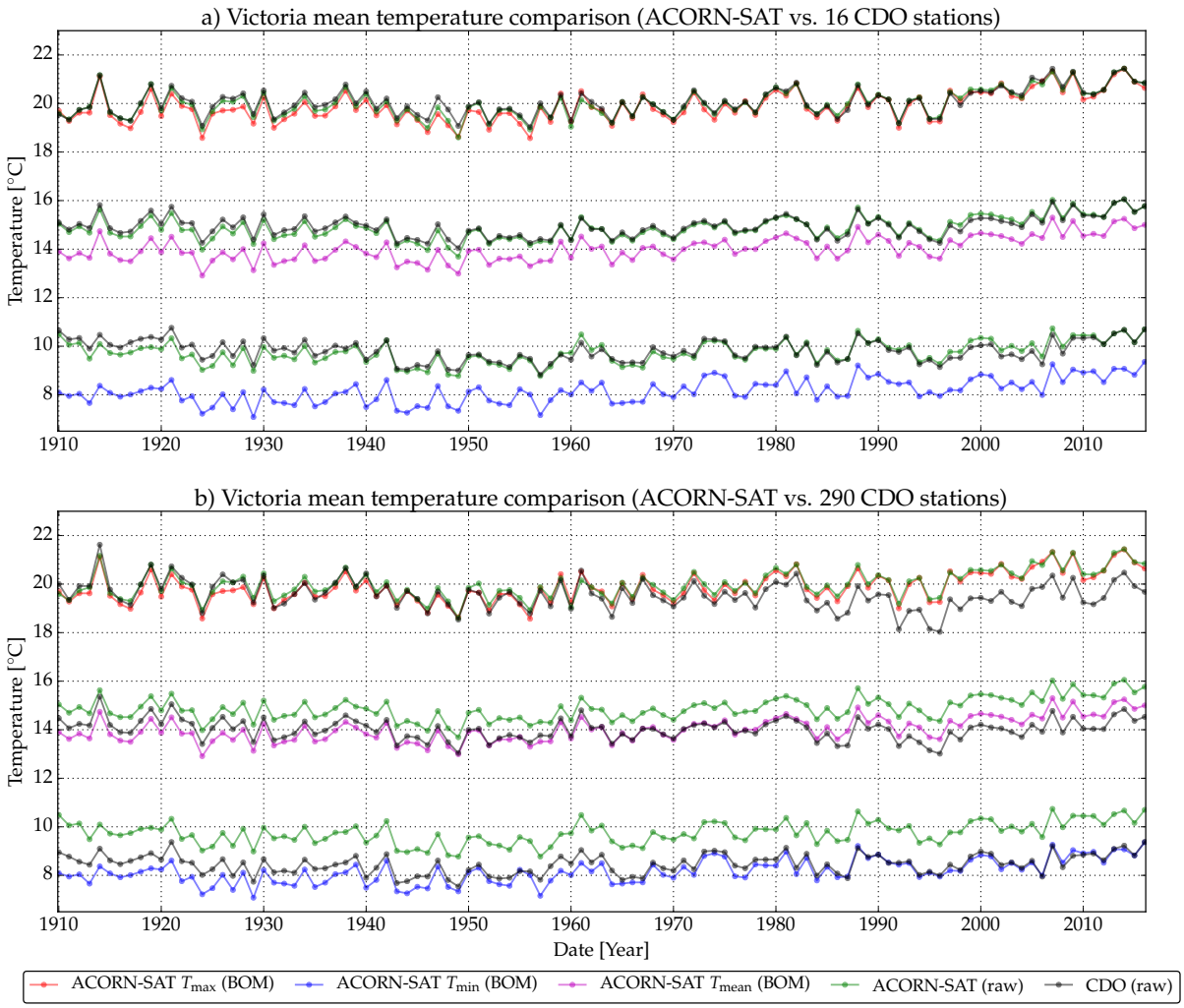

Figure 13: Victoria ACORN-SAT and CDO annual temperature trends for different CDO datasets.

Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

Fig. 13a shows that the raw $T_{\max}$ average of the 16 CDO data records is approximately the same as both the BOM-published and raw average of the ACORN-SAT data records. However, by simply averaging all Victorian CDO records, the trend suggests a smaller rate of temperature increase as illustrated in Fig. 13b.

A similar result is shown for $T_{\min}$; Fig. 13a shows that the raw averages of the ACORN-SAT and 16 CDO records are similar, except for small deviations in the early record (1910–1940) and also around 1997–2007. When all CDO records are simply averaged (Fig. 13b), there is a clear difference between the raw CDO and ACORN-SAT trends. Also, the BOM-published and raw ACORN-SAT trends show a seeming constant difference throughout the date range displayed.

As T_{mean} is simply the average between $T_{\max}$ and $T_{\min}$, the behaviour of the T_{mean} trend can be explained as the combination of $T_{\max}$ and $T_{\min}$ effects. Clearly, the average of the limited set of CDO stations matches the raw ACORN-SAT T_{mean}, but when all CDO stations are considered the trend deviates from the raw ACORN-SAT trend. From 1984 onward, the rate of increase is also smaller, which is due to the effect of $T_{\max}$.

Overall, Fig. 13 shows that the raw average of the 11 Victorian ACORN-SAT records correspond approximately with the raw average of the 16 CDO records that form part of the data used in the ACORN-SAT network. The raw averages deviate from the published BOM trends as the ACORN-SAT data are merely inputs to a larger algorithm that computes the published trends. The algorithm is based on anomaly temperature values, includes area weighting and data originating from other stations outside Victoria, and also excludes certain urban effects [7]. When all Victorian temperature records are considered, the trends are slightly different, as other factors are also included. For example, the 290 station set includes a number of cold Alpine stations introduced in the late 1980s which contribute to a lower rate of warming. In fact, as illustrated in Fig. 12, the overall CDO average shows cooling at a rate of 0.5°C per century.

4.2 Comparison between ACORN-SAT and CDO $T_{\max}$ records

This section presents a comparison between the ACORN-SAT and CDO maximum temperature data records, by only considering the Victorian records that contribute to the ACORN-SAT network. There are 11 ACORN-SAT sites in Victoria, although 16 CDO records are used as sources (also see Appendix A). The twelve-month MA temperature series of both datasets were computed for each station as in Section 3.1.

Figs. 14 and 15 show the respective results for the 16-station CDO and the 11-station ACORN-SAT data records, where the same color is used in both figures to represent the same ACORN-SAT site. The MA series displayed in Fig. 14a were computed from the monthly mean maximum records available at [1]. Similarly, the graphs shown in Fig. 15a were calculated using the daily temperature ACORN-SAT records available at [5].

The two figures show similar graphs for each ACORN-SAT site, which explains why the two raw average $T_{\max}$ trends in Fig. 13a correspond. A single ACORN-SAT record shown in Fig. 15 consists of one or more CDO records shown in Fig. 14. For example, the blue curve in Fig. 14 represents Mildura Post Office (76077) from 1910–1949 (with missing data around 1916) and Mildura Airport (76031) from 1946–2016. The overlapping period Aug 1946 – Dec 1949 is clearly visible. The blue curve in Fig. 15 shows the corresponding ACORN-SAT $T_{\max}$ curve for Mildura, which consists of the combined Post Office and Airport records - also displayed in Appendix A.

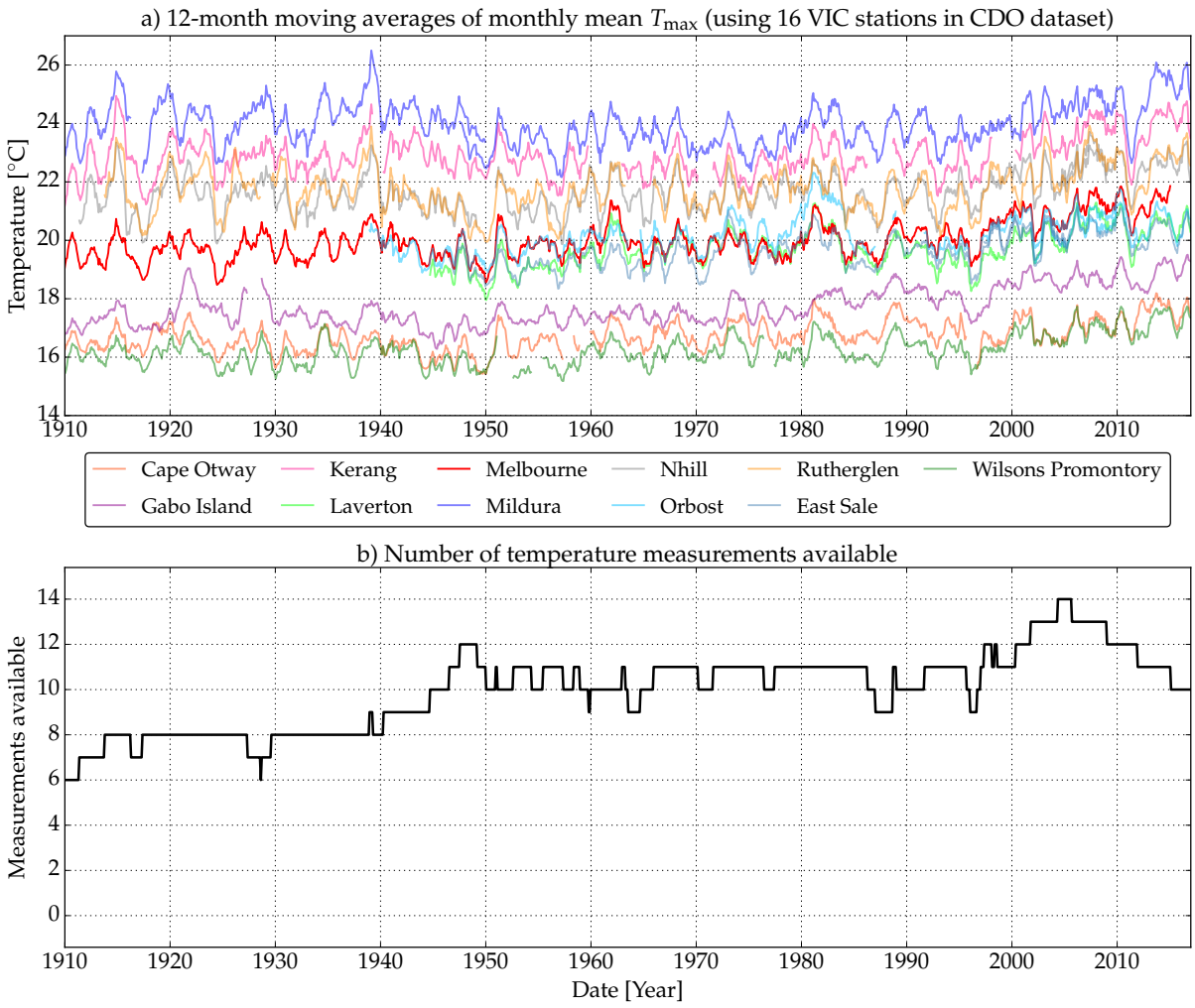

Figure 14: Moving average of 16 VIC CDO mean maximum temperature records.
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/

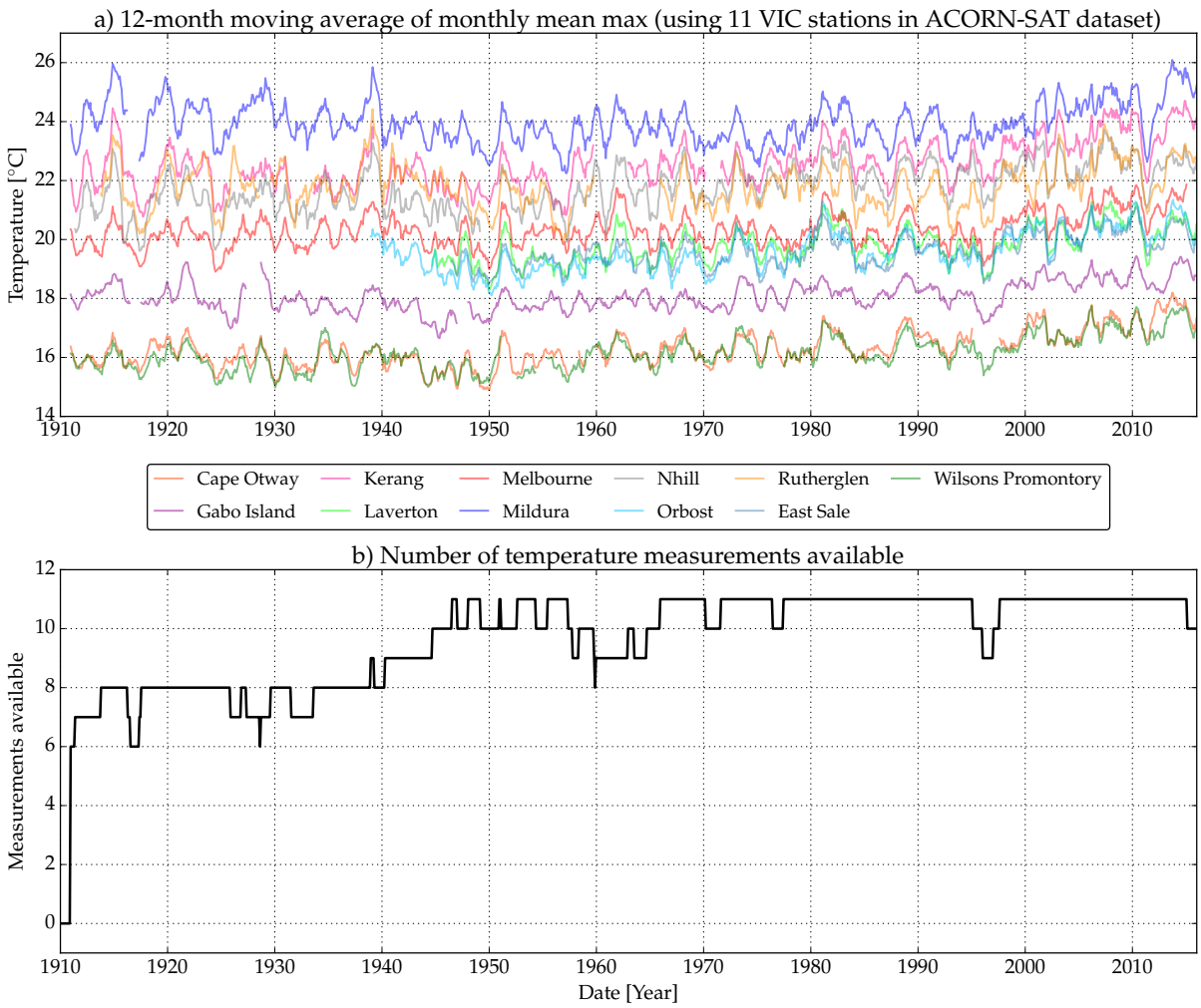

Figure 15: Moving average of 11 VIC ACORN mean maximum temperature records. Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

4.3 Comparison between raw and anomaly CDO $T_{\max}$ record

Fig. 16 shows the same graphs displayed in Fig. 12 with an additional anomaly graph included to compare the raw CDO average with its anomaly series. The blue graph (average CDO $T_{\max}$) is simply the annual station average of all available measurements across Victoria for any given year from 1910 to 2016. This graph will contain both geographical and temporal bias depending on the number and locations of stations available. Geographical bias is present due to the fact that only raw station records were used - no area weighting or interpolation methods were employed to include the temperature contribution from areas between weather stations. Temporal bias is also present, as every annual value in the average series was not calculated from the same number of stations. As shown in Fig. 4b, the number of stations in the weather network has changed over its history.

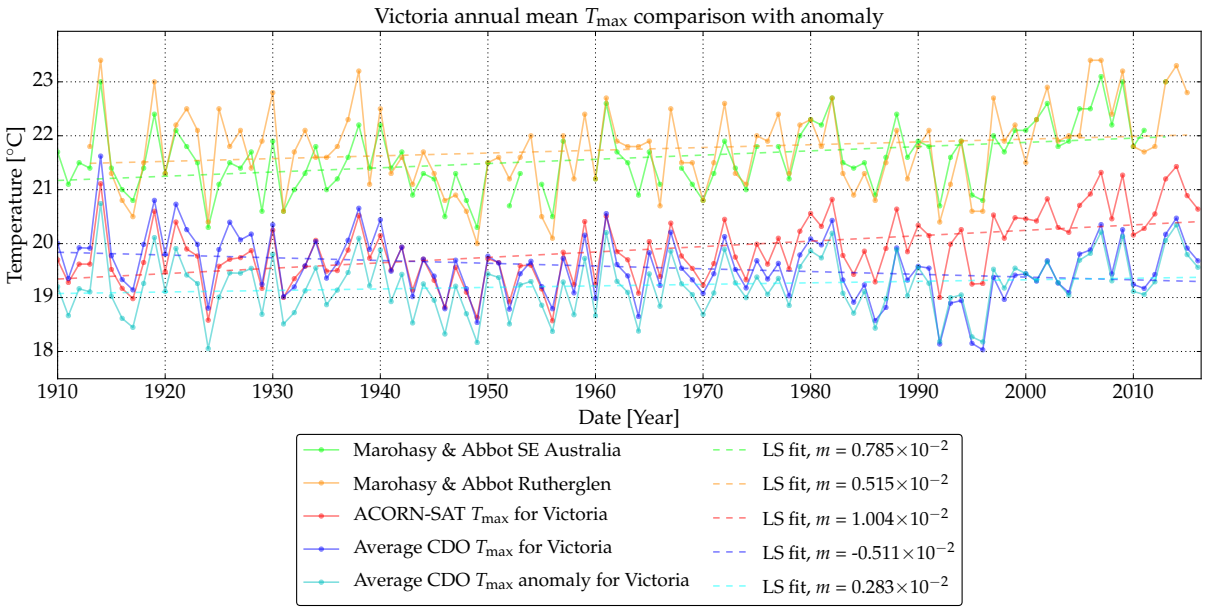

Figure 16: Comparison of Victoria annual temperature trends and CDO anomaly.
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

In an attempt to reduce the temporal bias, an anomaly graph is also shown in Fig. 16 in cyan. This series can be viewed as the deviation from average of all available CDO records, which was calculated as follows.

- The average value T_{a} of all available samples of a given CDO record T_{cdo} is calculated.
- The zero-mean series $T_{\mathrm{z}} = T_{\mathrm{cdo}} - T_{\mathrm{a}}$ is calculated for every CDO record.
- The average zero-mean anomaly T_0 is calculated as the average of all T_{z} series.

- The CDO anomaly graph depicted in Fig. 16 is then the sum of the T_0 series and the average of all T_a values.

This method will reduce bias somewhat as the contribution of every station is taken relative to its mean temperature and not according to its actual temperature level. The effect of the changing mix of stations contributing to the temperature record over time is therefore reduced. For example, if the mix include more stations from a cooler region for a short period of time, the average trend will not be pulled down artificially.

The result is that instead of cooling of 0.5°C (indicated by the blue graph in Fig. 16), warming of approximately 0.3°C per century is obtained using the anomaly graph (the cyan graph in Fig. 16) - which is still below the rate calculated using the ACORN-SAT record. Note that the CDO anomaly calculated here was not taken relative to a reference period (such as $1961 - 1990$ used in ACORN-SAT anomaly), but rather relative to the average of all available data throughout the history of each CDO record. The reason is that the number of active stations changes over time as depicted in Fig. 4b, and a fixed reference window will introduce bias of its own if not compensated with infilling and interpolation (which is done in ACORN-SAT).

Neither the average CDO T_{max} nor the associated anomaly graph fully solves the bias problem, as both are based on the raw station mean. A future study will address these issues by infilling missing values in individual records in combination with geographical interpolation on a regular grid. The approach will be to use all available raw data.

5 Discussion

To understand weather patterns, both individual locations and whole regions (or many individual locations) should be studied. Individual locations may be dominated by local effects, which are of concern for the immediate region. However, by averaging over a wide area, limited local effects are diminished while patterns observable by many individual stations are enhanced. Only by studying both individual stations and whole regions can a distinction be made between what is thought to be local or global effects.

To describe the temperature patterns of a region, ideally every infinitesimal area belonging to the region should be accounted for. Due to physical constraints, true average temperature values must be estimated from records that are obtained from sensors that are not necessarily ideally located. Missing or inaccurate data values should also be recognised and interpolated or corrected.

Instead of trying to obtain a true average value of a region, the average of all or a subset of weather stations in a region can be used to study temperature trends. In this report, the raw CDO record and the ACORN-SAT record of Victoria obtained from the Australian BOM were studied and compared. An attempt to reconstruct the average temperature trends of Victoria from the raw CDO data was made, which showed a high degree of correlation to other similar attempts.

It was shown that all the individual CDO weather records exhibit strong synchrony, although several records have long periods of missing data. As no attempt was made to interpolate missing data in this report, the resultant average temperature trend contains bias that varies over its history as the number of available samples also varies. As was shown in Fig. 8, a number of cold stations were commissioned in the early 1990s, which will inevitably reduce the average temperature values for the period where these new stations are included. However, by removing all these cold stations, the average temperature trend is still below the ACORN-SAT trend shown in Fig. 12. An alternative raw anomaly graph presented in Fig. 16 also indicates a reduced rate of warming.

To address the shortcomings of the approach presented in this study - to merely combine all the raw CDO data to calculate the average trend - a new study is underway to recover the missing data and also to estimate historic temperature values of locations not included in the Victorian weather station network. The aim is to develop a more accurate temperature reconstruction which can be used to obtain an average temperature series with less bias. As all stations in Victoria show temperature trends that move in unison

over time (both the maximum and to a lesser degree minimum records), missing data can be recovered through estimation using a neural network.

5.1 Limitations of raw mean method

Some limitations of merely averaging all available station records to describe the temperature trends for a given region are discussed below.

- The accuracy of the result depends on the layout of the weather station network. Areas with similar climate with more weather stations will be over-represented in the average. For example, coastal areas with higher population numbers and more weather stations will bias the average towards a coastal climate. Arid areas with less weather stations will likewise be under-represented.

- Bias in the average temperature trend will be dynamic. As old stations are moved or closed and new ones commissioned, the average temperature at any given moment will describe a different underlying sample set. For example (as already mentioned), in Victoria a number of cold Alpine stations were opened in the early 1990s. Inclusion of these cold stations in the sensor network reduces the average temperature, causing a seeming cooling trend from before the 1990s - which could be deceiving.

- Missing data at any given moment in the historic weather record will also introduce bias in the average towards the stations that happened to function correctly at the time.

- Human activity could also introduce phenomena in the weather record and hence the average, which could lead to deceiving patterns. For example, water works could introduce a local cooling effect and urban heat islands a local heating effect, which do not necessarily affect the state-wide or global temperature. Incorrect conclusions regarding temperature patterns (or climate change in general) can be made if these effects are not normalised (or at least reduced in the average by ensuring correct weighting).

To address these problems, interpolation or reconstruction over time and geographical location should be performed. Station and area weighting should also be incorporated into the average, and known unnatural effects should be reduced depending on what metric is to be extracted from the data. The proposed neural network approach could possibly address most of these limitations.

Appendix

A Victorian CDO vs ACORN data

The ACORN-SAT sites located in the state of Victoria with their associated weather stations are listed in Table 1. All these stations contribute temperature data to the ACORN-SAT network as detailed in the station catalogue [8].

Site number	ID	Contributing stations
1	90015	Cape Otway Lighthouse
2	84016	Gabo Island
3	80023	Kerang
4	87031	Laverton RAAF
	87177	Laverton Comparison
5	86071	Melbourne Regional Office
6	76031	Mildura Airport
	76077	Mildura Postoffice
7	78015	Nhill Aerodrome
	78031	Nhill
8	84145	Orbost
	84030	Orbost Comparison
9	82039	Rutherglen Research
10	85072	East Sale Airport
	85298	East Sale Comparison
11	85096	Wilsons Promontory

Table 1: Victorian weather stations that contribute data to the ACORN-SAT network according to ACORN-SAT station catalogue [8] available at http://www.bom.gov.au/climate/change/acorn-sat/documents/ACORN-SAT-Station-Catalogue-2012-WEB.pdf.

A.1 Mean temperature trends

Fig. 17 shows a comparison between the mean twelve-month MA CDO and ACORN-SAT temperature trends of all Victorian weather stations in the ACORN-SAT network. The ACORN-SAT $T_{\max}$, $T_{\min}$ and T_{mean} graphs were obtained by first averaging all monthly data (obtained by averaging the daily data obtained from [5]) and then calculating the MA trend[4]. Similarly, each mean CDO MA trend associated with $T_{\max}$, $T_{\min}$ and T_{mean} is also the MA of the mean of all monthly data.

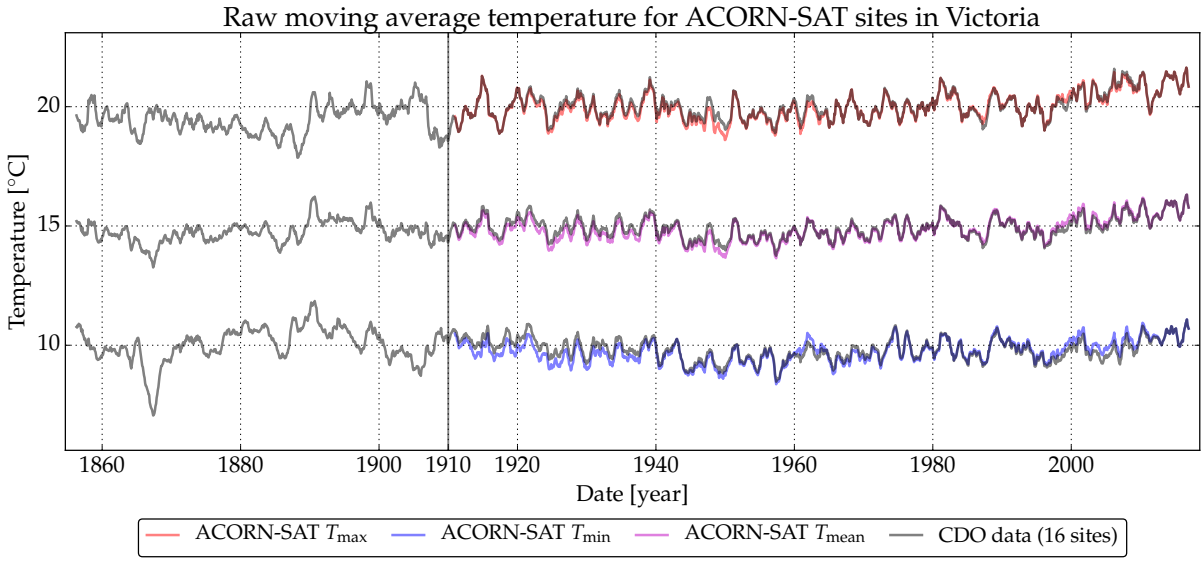

Figure 17: Mean trends of CDO and ACORN recordings of ACORN weather stations in Victoria.

Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

Figs. 18 to 28 show comparisons between the raw CDO and ACORN-SAT data records of the 11 Victorian ACORN-SAT sites, which include the 16 stations listed in Table 1. Each ACORN-SAT graph is the twelve-month MA of an individual mean monthly record, which was calculated from the daily data available at [5]. Similarly, each CDO graph is the twelve-month MA of an individual mean monthly record available at [1]. All CDO datasets contributing to a single ACORN-SAT site are shown on the same figure, with the ACORN-SAT graph computed from the ACORN-SAT daily data.

[4] The resultant MA trend is similar to the mean of the MA curves shown in e.g. Fig. 15 - if there were no missing data the two would be identical.

A.2 Cape Otway Lighthouse

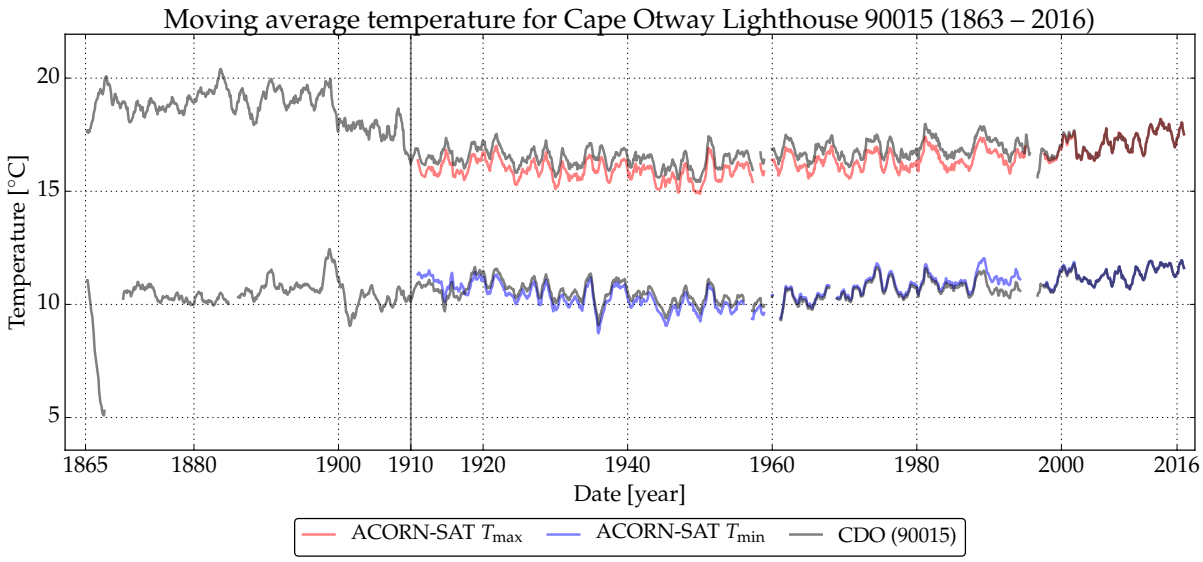

Figure 18: CDO vs ACORN-SAT data record comparison for Cape Otway (90015). Each year value indicated on the x-axis corresponds to January of that year.
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

Parameter	Start date	End date	Duration	% Complete
ACORN-SAT T_{min}	Jan 1910	Dec 2016	107 years, 0 months	98.6
ACORN-SAT T_{max}	Jan 1910	Dec 2016	107 years, 0 months	99.5
CDO (90015) T_{min}	Apr 1864	Dec 2016	152 years, 9 months	98.4
CDO (90015) T_{max}	Apr 1864	Dec 2016	152 years, 9 months	99.8

Table 2: Temperature data record lengths associated with Cape Otway Lighthouse (90015).
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

Description according to Australian BOM ACORN-SAT station catalogue [8]:

> "The screen was reported as being in poor condition, and replaced, in July 1954. There was a small site move in September 1966. The first automatic weather station was installed on 15 April 1994, but this proved unreliable and it was replaced in March 1995."

A.3 Gabo Island Lighthouse

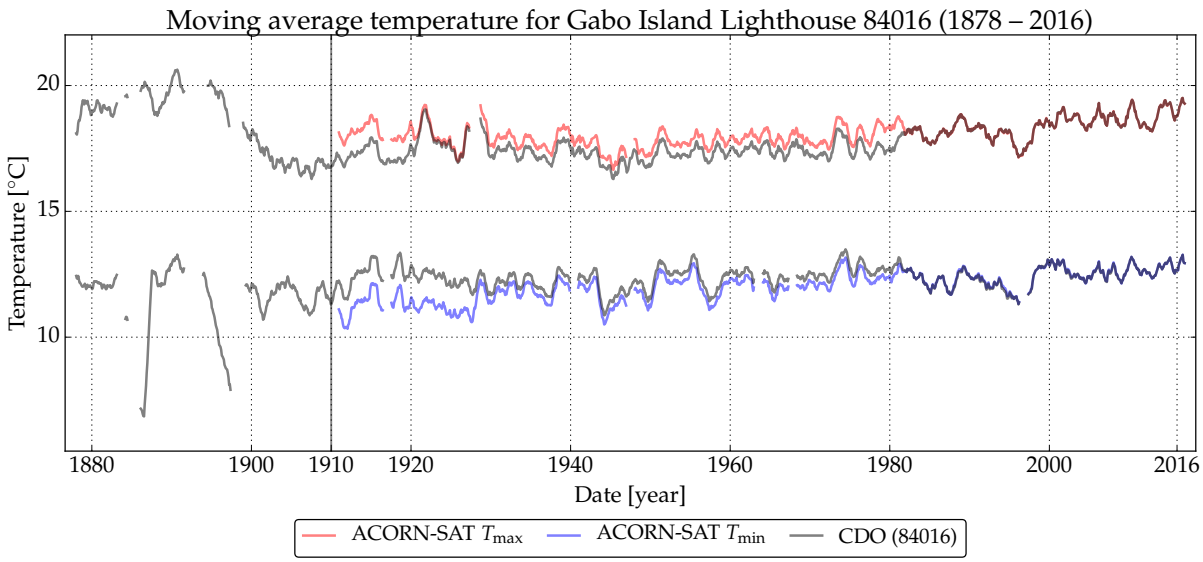

Figure 19: CDO vs ACORN-SAT data record comparison for Gabo Island (84016).
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

Parameter	Start date	End date	Duration	% Complete
ACORN-SAT T_{min}	Jan 1910	Dec 2016	107 years, 0 months	99.4
ACORN-SAT T_{max}	Jan 1910	Dec 2016	107 years, 0 months	99.5
CDO (84016) T_{min}	Feb 1877	Dec 2016	139 years, 11 months	98.0
CDO (84016) T_{max}	Feb 1877	Dec 2016	139 years, 11 months	98.1

Table 3: Temperature data record lengths associated with Gabo Island Lighthouse (84016).
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

Description according to Australian BOM ACORN-SAT station catalogue [8]:

> "The site has been in the general vicinity of the islands lighthouse throughout its history. New screens were installed in September 1927 and July 1961. On 13 March 1981 the site was moved away from the lighthouse buildings. The automatic weather station was installed in August 2000 but only used for wind observations until August 2007."

A.4 Kerang

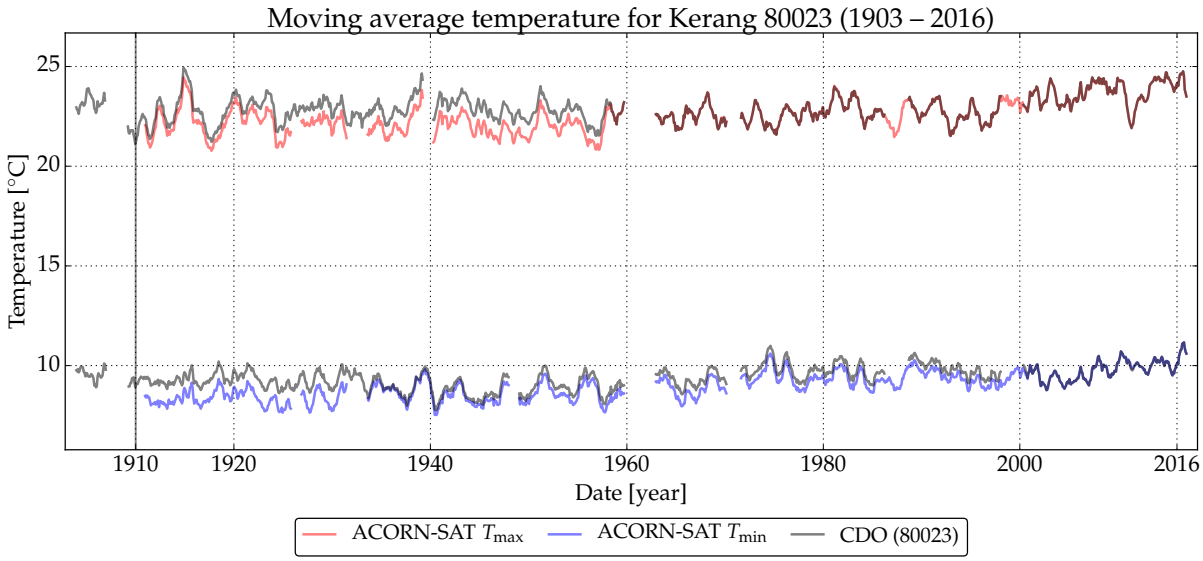

Figure 20: CDO vs ACORN-SAT data record comparison for Kerang (80023).
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

Parameter	Start date	End date	Duration	% Complete
ACORN-SAT T_{min}	Jan 1910	Dec 2016	107 years, 0 months	97.1
ACORN-SAT T_{max}	Jan 1910	Dec 2016	107 years, 0 months	97.1
CDO (80023) T_{min}	Jan 1903	Dec 2016	114 years, 0 months	95.2
CDO (80023) T_{max}	Jan 1903	Dec 2016	114 years, 0 months	95.2

Table 4: Temperature data record lengths associated with Kerang (80023).
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

Description according to Australian BOM ACORN-SAT station catalogue [8]:

> "The site has been within the township since it was established. It moved in August 1932, June 1956 and June 1957; the latter placed it in a yard within a built-up area which was cluttered from time to time. The screen was noted as being incorrectly oriented in November 1945 and again in February 1968. The site moved 1 km north to its current location on 18 January 2000."

A.5 Laverton RAAF

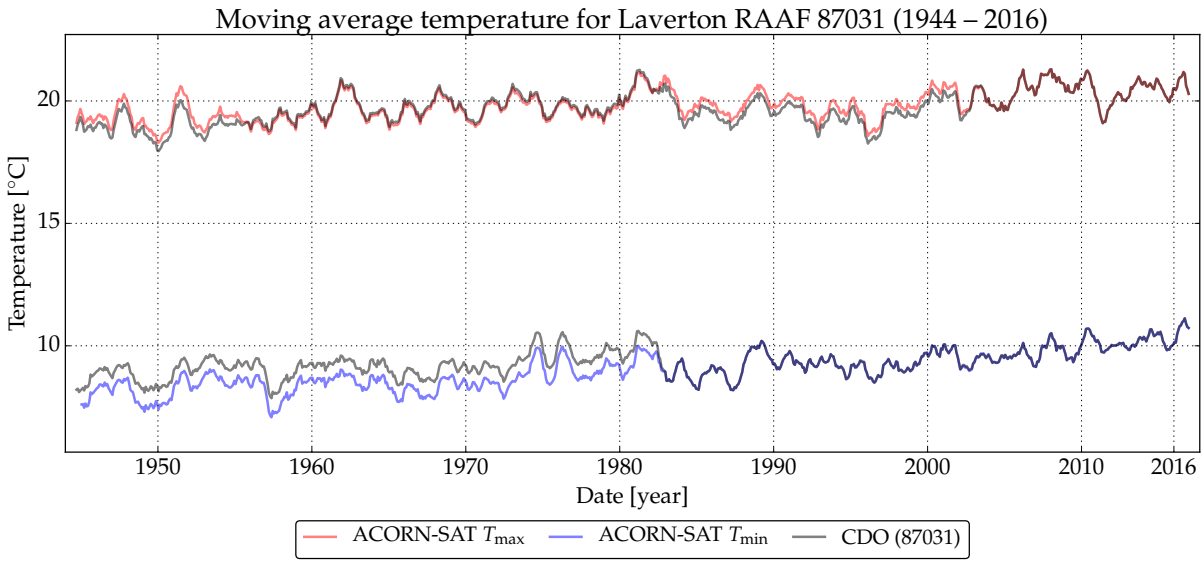

Figure 21: CDO vs ACORN-SAT data record comparison for Laverton (87031).
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

Parameter	Start date	End date	Duration	% Complete
ACORN-SAT T_{min}	Oct 1943	Dec 2016	73 years, 3 months	99.9
ACORN-SAT T_{max}	Oct 1943	Dec 2016	73 years, 3 months	100.0
CDO (87031) T_{min}	Oct 1943	Dec 2016	73 years, 3 months	100.0
CDO (87031) T_{max}	Oct 1943	Dec 2016	73 years, 3 months	100.0

Table 5: Temperature data record lengths associated with Laverton Raaf (87031).
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

Description according to Australian BOM ACORN-SAT station catalogue [8]:

> "The site was originally a Meteorological Office; there is no clear evidence of moves before 1997. An automatic weather station was installed on 22 February 1997, about 1.2 km northeast of the previous site (which continued until July 1998 under the station number 087177). Whilst there has been no significant building on the base grounds, the surrounding region is a major urban growth corridor and a new housing development has been built in recent years a few hundred metres west of the site. There is evidence of recent anomalous urban warming in the minimum temperature data."

A.6 Melbourne Regional Office

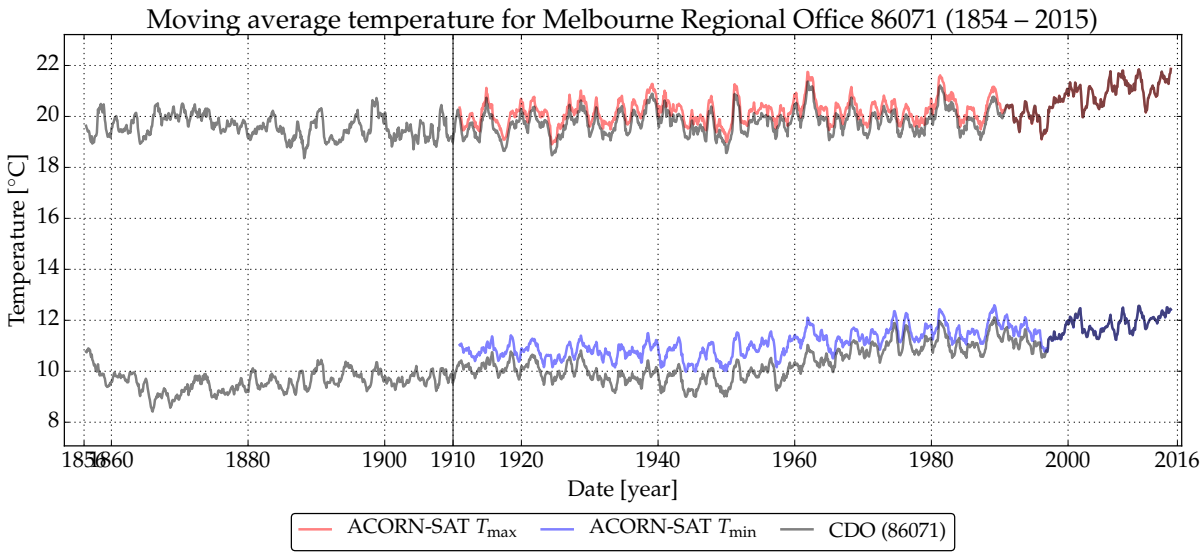

Figure 22: CDO vs ACORN-SAT data record comparison for Melbourne (86071).
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

Parameter	Start date	End date	Duration	% Complete
ACORN-SAT T_{min}	Jan 1910	Jan 2015	105 years, 1 months	100.0
ACORN-SAT T_{max}	Jan 1910	Jan 2015	105 years, 1 months	100.0
CDO (86071) T_{min}	May 1855	Jan 2015	159 years, 9 months	100.0
CDO (86071) T_{max}	May 1855	Jan 2015	159 years, 9 months	100.0

Table 6: Temperature data record lengths associated with Melbourne Regional Office (86071).
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

Description according to Australian BOM ACORN-SAT station catalogue [8]:

> "The site has been in its current location, on the northeastern edge of the junction of Victoria and La Trobe streets, since January 1908. There were strong rises in minimum temperature through the late 1950s and 1960s, possibly associated with increasing levels of road traffic (the lack of further increases after 1970 may indicate that by then the traffic was at saturation level from the viewpoint of its effect on the observations). An automatic weather station has been in place since August 1986 and became the primary instrument on 1 November 1996. A large apartment building was built across the street to the south

of the site in 1996--1997, which coincides with a discernible rise in minimum temperatures. Earlier observations were made at the old Melbourne Observatory (in the Domain south of the Yarra River) from 1863 to 1907, and in a number of locations in the vicinity of Flagstaff Hill prior to 1863."

A.7 Mildura

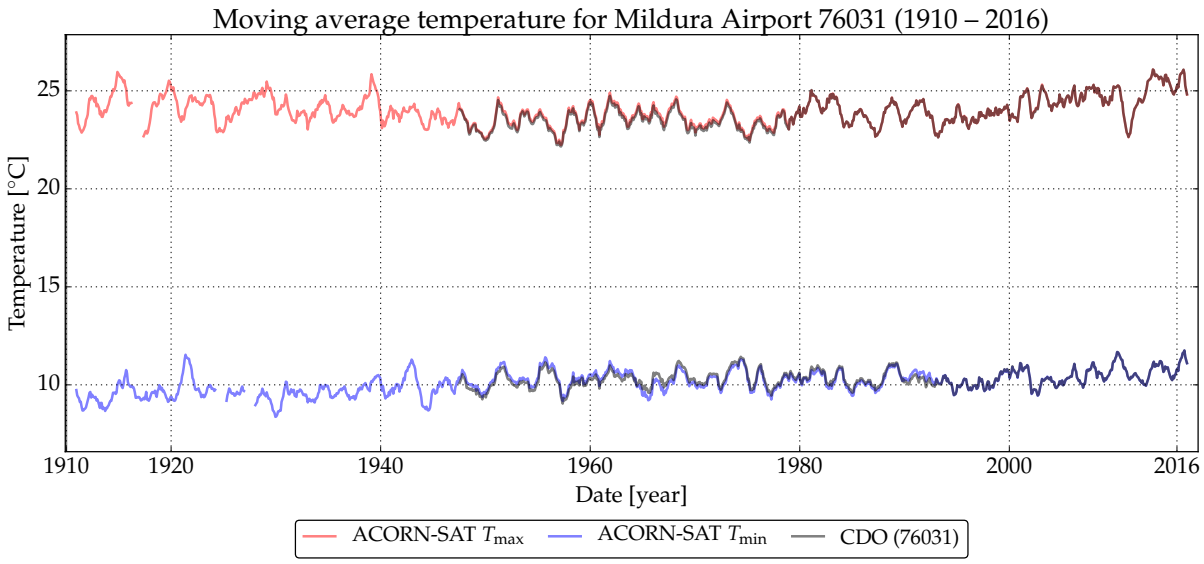

Figure 23: CDO vs ACORN-SAT data record comparison for Mildura (76031).
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

Parameter	Start date	End date	Duration	% Complete
ACORN-SAT T_{min}	Jan 1910	Dec 2016	107 years, 0 months	99.8
ACORN-SAT T_{max}	Jan 1910	Dec 2016	107 years, 0 months	99.8
CDO (76031) T_{min}	Aug 1946	Dec 2016	70 years, 5 months	100.0
CDO (76031) T_{max}	Aug 1946	Dec 2016	70 years, 5 months	100.0

Table 7: Temperature data record lengths associated with Mildura Airport (76031).
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

Description according to Australian BOM ACORN-SAT station catalogue [8]:

> "The original site (076077) was within the Mildura town area. It moved in August 1927. After this move the screen was oriented northeast, but it was realigned to face south in July 1933. There was a small site move in March 1943. Temperature observations continued until 1949. Observations have been made at the airport site (076031) since 1946. Site moves took place on 11 August 1992 (from the aerodrome apron to the Meteorological Office) and in July 1989 (only a small move). The automatic weather station was installed on 1 October 1989, and became the primary instrument on 1 November 1996. There was rapid development of irrigated agriculture in the Mildura region in the

period between the two World Wars, and this appears to be associated with an anomalous cooling trend in maximum temperature at Mildura over this period (amounting to 0.3--0.4°C over 30 years). The non-ACORN-SAT site of Griffith, which has a similar history of irrigation development, shows a similar trend."

A.8 Nhill

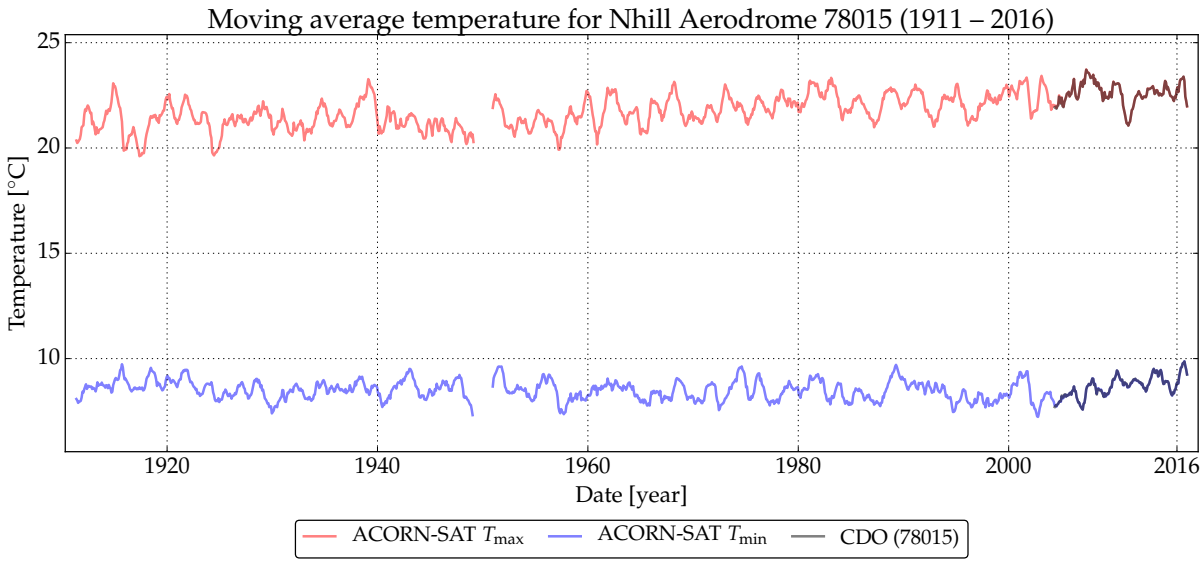

Figure 24: CDO vs ACORN-SAT data record comparison for Nhill (78015).
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

Parameter	Start date	End date	Duration	% Complete
ACORN-SAT T_{min}	Jun 1910	Dec 2016	106 years, 7 months	99.1
ACORN-SAT T_{max}	Jun 1910	Dec 2016	106 years, 7 months	99.2
CDO (78015) T_{min}	Jun 2003	Dec 2016	13 years, 7 months	100.0
CDO (78015) T_{max}	Jun 2003	Dec 2016	13 years, 7 months	100.0

Table 8: Temperature data record lengths associated with Nhill Aerodrome (78015).
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

Description according to Australian BOM ACORN-SAT station catalogue [8]:

> "The original site (078031) has been in a number of locations in and around Nhill. Starting within the township, the site moved in July 1930, August 1949 (town to airport), March 1966 (airport back into town), November 1970 (across the street), March 1976, August 1992 (only a small move) and the start of 1995 (about 500 m). The final location was on the southwestern edge of the town area, 1.2 km west of the centre. The current site at the airport (078015) has been operating since 2003. It is about 1 km northeast of the location used by 078031 from 1949 to 1966."

A.9 Orbost

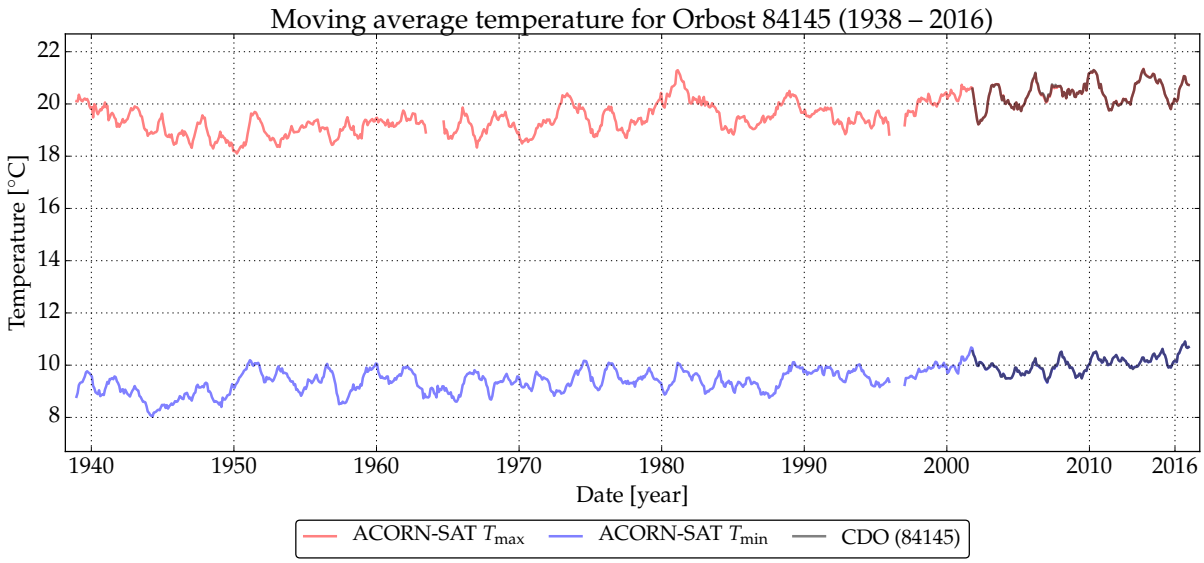

Figure 25: CDO vs ACORN-SAT data record comparison for Orbost (84145).
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

Parameter	Start date	End date	Duration	% Complete
ACORN-SAT T_{min}	Jan 1938	Dec 2016	79 years, 0 months	99.9
ACORN-SAT T_{max}	Jan 1938	Dec 2016	79 years, 0 months	99.6
CDO (84145) T_{min}	Nov 2000	Dec 2016	16 years, 2 months	100.0
CDO (84145) T_{max}	Nov 2000	Dec 2016	16 years, 2 months	100.0

Table 9: Temperature data record lengths associated with Orbost (84145).
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

Description according to Australian BOM ACORN-SAT station catalogue [8]:

> "The original site (084030) was in a number of locations with in the Orbost town area. It moved on 23 November 1966 and again on 4 March 1976. A move on 18 April 1984 placed it in a small paddock on the northern edge of town, where it continued until its closure in November 2011. The current site has been operating since November 2000."

A.10 Rutherglen

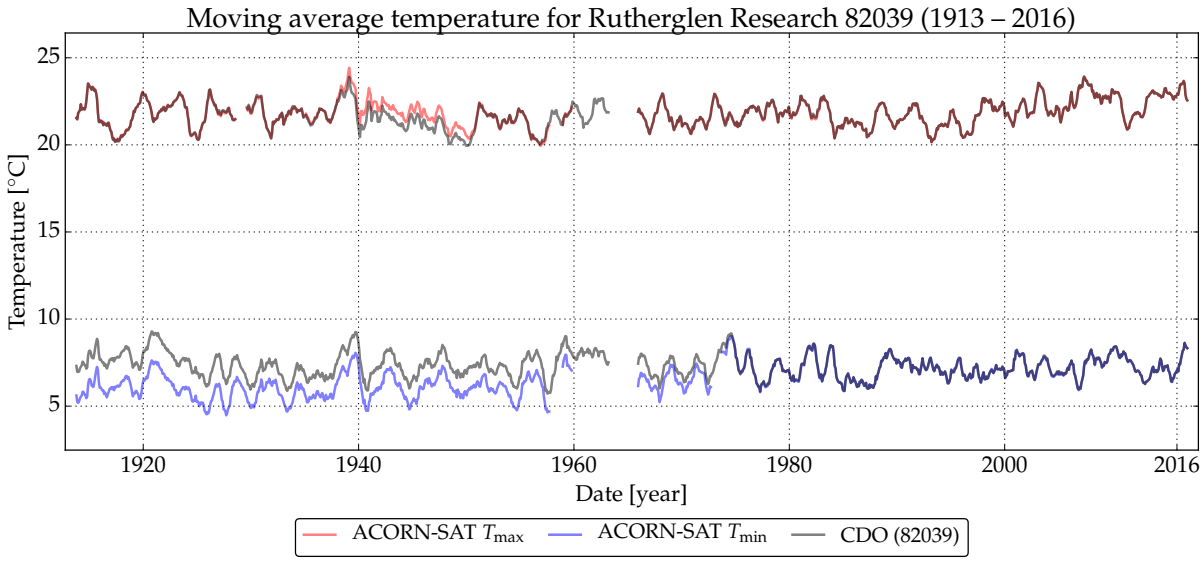

Figure 26: CDO vs ACORN-SAT data record comparison for Rutherglen (82039).
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

Parameter	Start date	End date	Duration	% Complete
ACORN-SAT T_{min}	Nov 1912	Dec 2016	104 years, 2 months	94.7
ACORN-SAT T_{max}	Nov 1912	Dec 2016	104 years, 2 months	94.7
CDO (82039) T_{min}	Nov 1912	Dec 2016	104 years, 2 months	99.0
CDO (82039) T_{max}	Nov 1912	Dec 2016	104 years, 2 months	98.9

Table 10: Temperature data record lengths associated with Rutherglen Research (82039).
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

Description according to Australian BOM ACORN-SAT station catalogue [8]:

> "There have been no documented site moves during the sites history.
> The automatic weather station began operations on 29 January 1998."

A.11 Sale

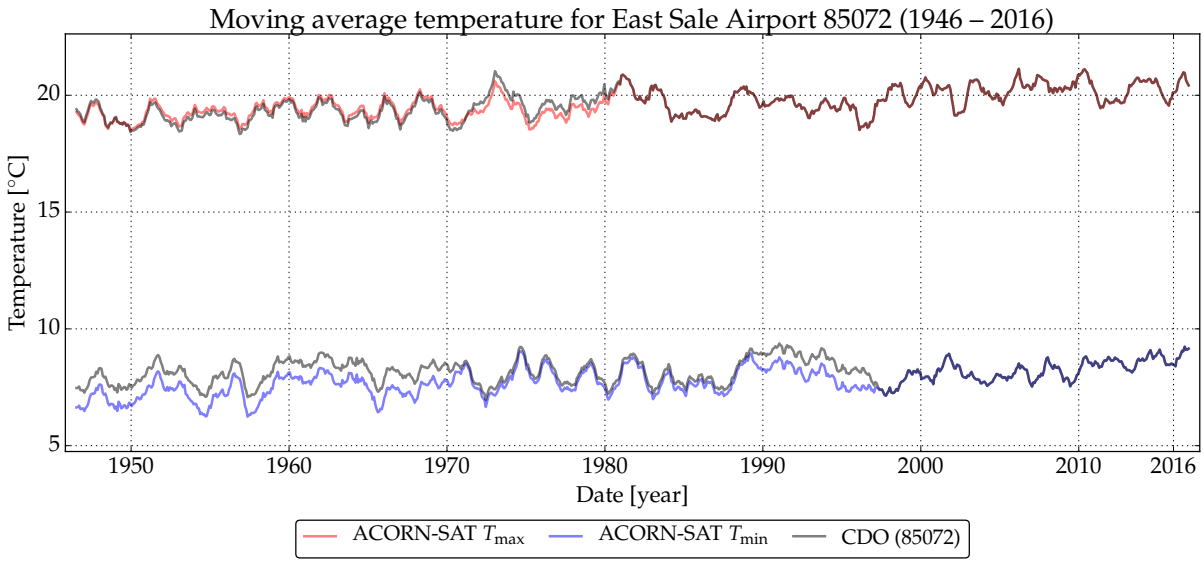

Figure 27: CDO vs ACORN-SAT data record comparison for Sale (85072).
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

Note that the data of Sale station 85133 have not been included ACORN-SAT, though it is shown in Fig. 27 as reference.

Parameter	Start date	End date	Duration	% Complete
ACORN-SAT T_{min}	Aug 1945	Dec 2016	71 years, 5 months	100.0
ACORN-SAT T_{max}	Aug 1945	Dec 2016	71 years, 5 months	100.0
CDO (85072) T_{min}	Aug 1945	Dec 2016	71 years, 5 months	100.0
CDO (85072) T_{max}	Aug 1945	Dec 2016	71 years, 5 months	100.0

Table 11: Temperature data record lengths associated with East Sale Airport (85072).
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

Description according to Australian BOM ACORN-SAT station catalogue [8]:

> "The automatic weather station has been operating in its present location since 11 June 1996. The previous site was 900 m north of the current site. It continued making observations as a comparison until 2005 under the station number 085298. There is no clear documentation of any moves at the RAAF base site prior to 1996. Prior to the opening of the Meteorological Office at the RAAF base in 1945, observations were made in the Sale

township (085133), but no data from this location had been digitised at the time of ACORN-SAT compilation."

A.12 Wilsons Promontory

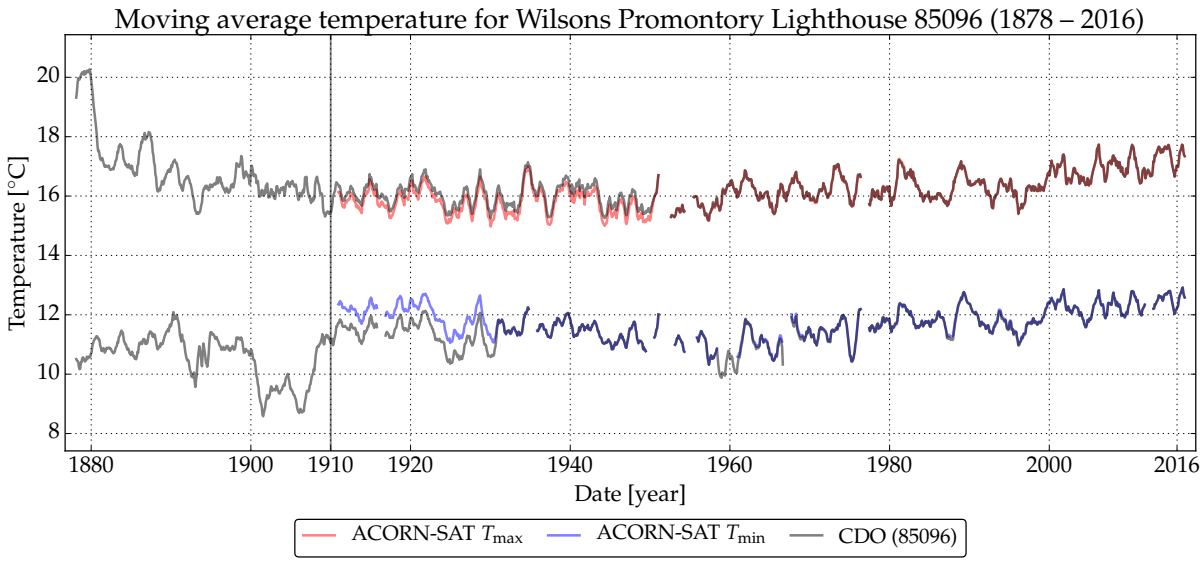

Figure 28: CDO vs ACORN-SAT data record comparison for Wilsons Promontory (85096).
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

Parameter	Start date	End date	Duration	% Complete
ACORN-SAT T_{min}	Jan 1910	Dec 2016	107 years, 0 months	97.7
ACORN-SAT T_{max}	Jan 1910	Dec 2016	107 years, 0 months	99.3
CDO (85096) T_{min}	Mar 1877	Dec 2016	139 years, 10 months	98.7
CDO (85096) T_{max}	Mar 1877	Dec 2016	139 years, 10 months	99.5

Table 12: Temperature data record lengths associated with Wilsons Promontory Lighthouse (85096).
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

Description according to Australian BOM ACORN-SAT station catalogue [8]:

> "This site has been located at the Wilsons Promontory lighthouse throughout its history, with no documented moves during the ACORN-SAT period. Bushfires affected the area in February 1951; the instrument enclosure was not directly affected but observations stopped for several months while staff housing was rebuilt. The screen was blown down in a June 1959 storm and had to be replaced. An automatic weather station was installed on 18 September 2000. Another bushfire in April 2005 also had no direct impact on the enclosure."

B Statistical values for annual trends

This appendix provides some statistical values for the annual temperature trends shown in Fig. 13. The statistics include the mean, standard error[5], variance, and slope of the linear LS fit to the annual trend.

The p-value of the two-sided t-test is also given[6]. The null hypothesis $\mathcal{H}_0$ of this test is that the slope is zero. The statistical significance can be determined from the given p-value and a chosen significance level[7] α. If $p < \alpha$, $\mathcal{H}_0$ can be rejected at the significance level α (typical values are 0.01, 0.05 and 0.1) - and hence the trend can be said to be statistically significant. Table 13 contains all values, which are subsequently given again in separate tables with the corresponding graphs in Figs. 29 to 34. The highlighted p-value cells in Table 13 indicate statistical significance at significance level $\alpha = 0.05$.

The slope values associated with highlighted p-value cells in Table 13 can therefore be said to be statistically significant, as $\mathcal{H}_0$ (the slope is zero) can be rejected.

[5] $\frac{\sigma}{\sqrt{N}}$ with σ the standard deviation and N the number of samples
[6] Calculated using the Scientific Python routine `scipy.stats.linregress`
[7] The probability of rejecting the null hypothesis when it is in fact true.

Parameter	Period	Mean (°C)	Standard error	Variance	Slope per century	p-value (t-test)	Nr of samples
1. Victoria ACORN-SAT from published annual anomaly values							
T_{max}	1910–2016	19.875	5.980e-02	0.383	1.004	3.787e-08	107
T_{min}	1910–2016	8.159	4.840e-02	0.251	0.939	6.369e-11	107
T_{mean}	1910–2016	14.023	4.865e-02	0.253	0.970	1.363e-11	107
2. Victoria ACORN-SAT from official homogenized daily values							
T_{max}	1910–2016	20.002	5.588e-02	0.334	0.855	7.452e-07	107
T_{min}	1910–2016	9.748	4.444e-02	0.211	0.546	1.024e-04	107
T_{mean}	1910–2016	14.875	4.541e-02	0.221	0.701	5.935e-07	107
3. Victoria raw mean of 16 CDO monthly records used in ACORN-SAT network							
T_{max}	1910–2016	20.060	5.386e-02	0.310	0.718	2.157e-05	107
T_{min}	1910–2016	9.818	4.212e-02	0.190	-0.012	9.288e-01	107
T_{mean}	1910–2016	14.939	4.163e-02	0.185	0.353	8.507e-03	107
4. Victoria raw mean of all CDO monthly records							
T_{max}	1910–2016	19.569	5.708e-02	0.349	-0.511	5.339e-03	107
T_{min}	1910–2016	8.462	3.958e-02	0.168	0.240	6.174e-02	107
T_{mean}	1910–2016	14.016	4.141e-02	0.183	-0.136	3.163e-01	107
5. Rutherglen ACORN-SAT from homogenised daily values							
T_{max}	1913–2016	21.821	7.911e-02	0.601	0.377	1.424e-01	96
T_{min}	1913–2016	6.610	8.943e-02	0.768	1.721	3.127e-11	96
T_{mean}	1913–2016	14.213	6.167e-02	0.361	1.054	1.043e-08	95
6. Rutherglen from raw CDO monthly values							
T_{max}	1913–2016	21.763	7.724e-02	0.603	0.547	3.229e-02	101
T_{min}	1913–2016	7.307	6.810e-02	0.473	-0.272	2.308e-01	102
T_{mean}	1913–2016	14.535	5.074e-02	0.260	0.139	4.139e-01	101

Table 13: Statistical values for annual mean temperature trends.

Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/ and http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks and http://www.bom.gov.au/climate/change/#tabs=Tracker&tracker=timeseries

B.1 BOM-published anomaly values

The results shown in Fig. 29 were derived from the published BOM anomaly values available at [4], as discussed in Section 4.1.

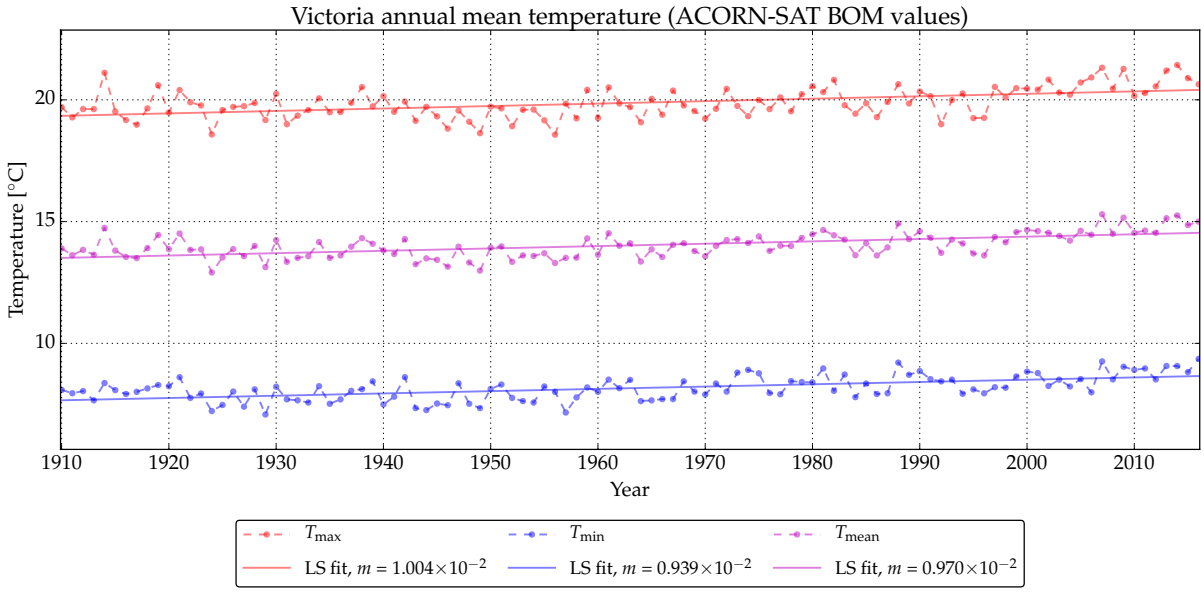

Figure 29: BOM-published ACORN-SAT annual temperature trends for Victoria.

Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/change/#tabs=Tracker&tracker=timeseries

Parameter	Period	Mean (°C)	Standard error	Variance	Slope per century	p-value (t-test)	Nr of samples
T_{max}	1910–2016	19.875	5.980e-02	0.383	1.004	3.787e-08	107
T_{min}	1910–2016	8.159	4.840e-02	0.251	0.939	6.369e-11	107
T_{mean}	1910–2016	14.023	4.865e-02	0.253	0.970	1.363e-11	107

Table 14: Statistical values for Victoria annual mean temperature (ACORN-SAT BOM values)

Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/change/#tabs=Tracker&tracker=timeseries

B.2 Raw average of daily ACORN-SAT data records

The results shown in Fig. 30 were obtained using the raw ACORN-SAT daily temperature data of Victoria (11 records available), as discussed in Section 4.1.

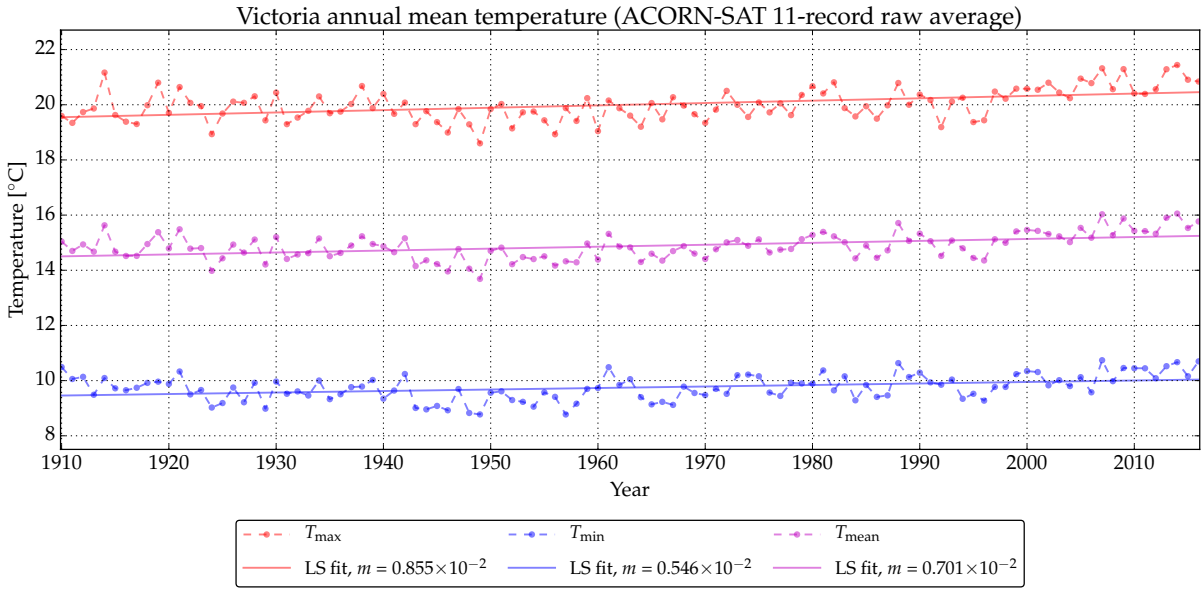

Figure 30: ACORN-SAT 11-record raw mean annual temperature trends for Victoria.
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/change/#tabs=Tracker&tracker=timeseries

Parameter	Period	Mean (°C)	Standard error	Variance	Slope per century	p-value (t-test)	Nr of samples
T_{max}	1910–2016	20.002	5.588e-02	0.334	0.855	7.452e-07	107
T_{min}	1910–2016	9.748	4.444e-02	0.211	0.546	1.024e-04	107
T_{mean}	1910–2016	14.875	4.541e-02	0.221	0.701	5.935e-07	107

Table 15: Statistical values for Victoria annual mean temperature (ACORN-SAT 11-record raw average)
Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/change/#tabs=Tracker&tracker=timeseries

B.3 Raw average of CDO records used in ACORN-SAT

The results shown in Fig. 31 were obtained using the raw CDO monthly temperature data that are used in the ACORN-SAT network of Victoria (16 records), as discussed in Section 4.1 and Appendix A.

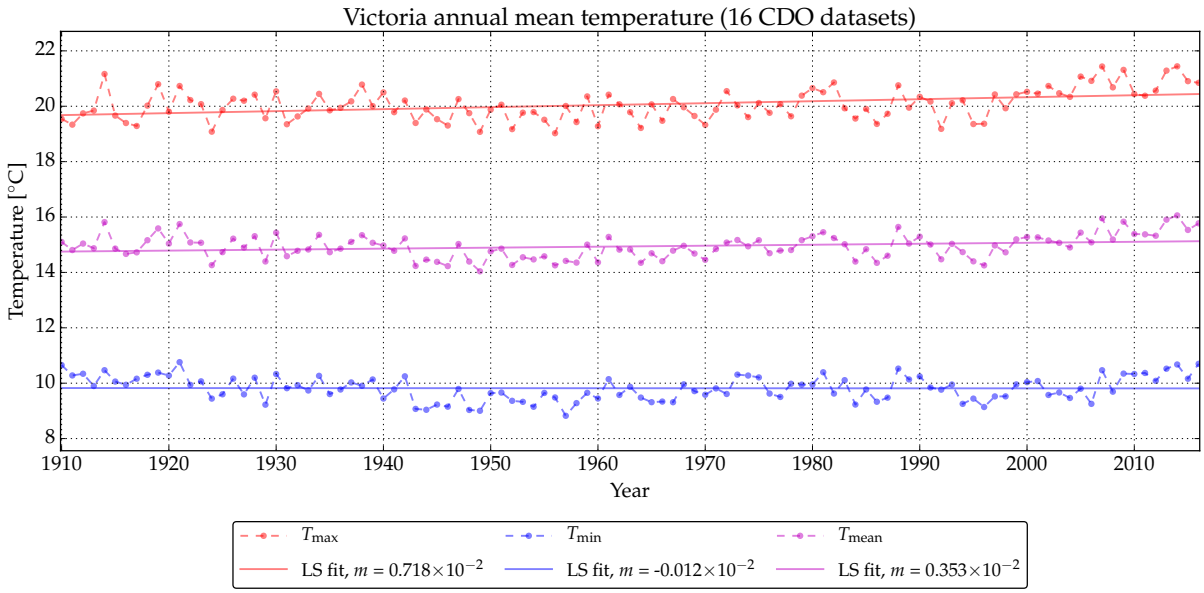

Figure 31: CDO 16-record raw mean annual temperature trends for Victoria.

Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/

Parameter	Period	Mean (°C)	Standard error	Variance	Slope per century	p-value (t-test)	Nr of samples
T_{max}	1910–2016	20.060	5.386e-02	0.310	0.718	2.157e-05	107
T_{min}	1910–2016	9.818	4.212e-02	0.190	-0.012	9.288e-01	107
T_{mean}	1910–2016	14.939	4.163e-02	0.185	0.353	8.507e-03	107

Table 16: Statistical values for Victoria annual mean temperature (16 CDO datasets)

Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/

B.4 Raw average of all available CDO records in Victoria

The results shown in Fig. 32 were obtained using all the raw CDO monthly temperature data available for Victoria (290 records), as discussed in Section 4.1.

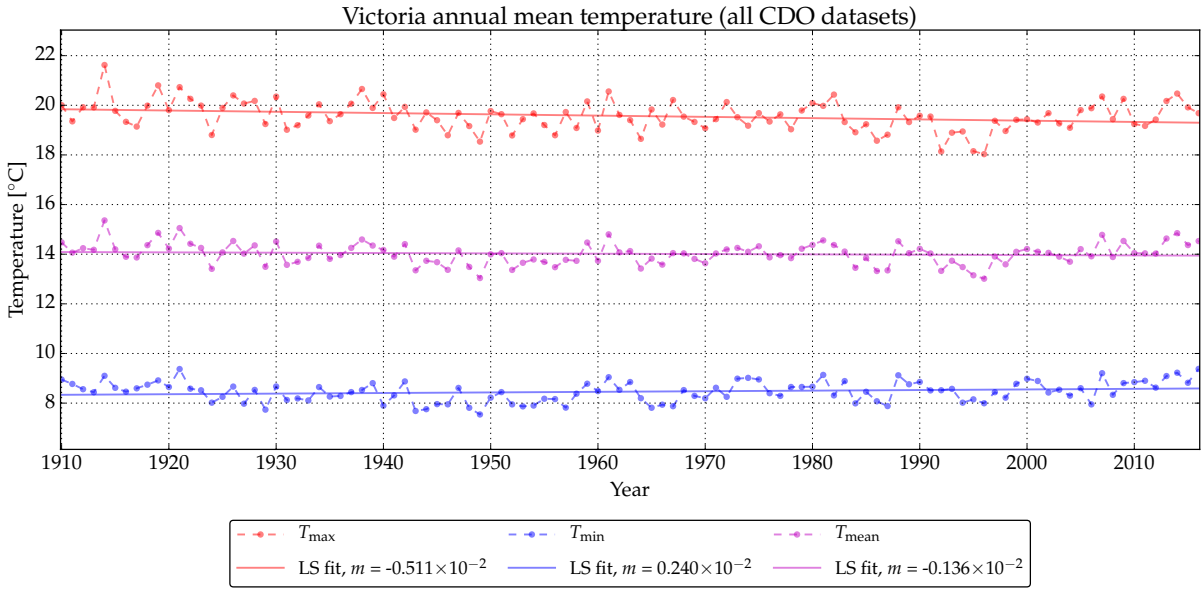

Figure 32: CDO raw mean annual temperature trends for Victoria.

Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/

Parameter	Period	Mean (°C)	Standard error	Variance	Slope per century	p-value (t-test)	Nr of samples
T_{max}	1910–2016	19.569	5.708e-02	0.349	-0.511	5.339e-03	107
T_{min}	1910–2016	8.462	3.958e-02	0.168	0.240	6.174e-02	107
T_{mean}	1910–2016	14.016	4.141e-02	0.183	-0.136	3.163e-01	107

Table 17: Statistical values for Victoria annual mean temperature (all CDO datasets)

Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/

B.5 Rutherglen ACORN-SAT record

The results shown in Fig. 33 were obtained using the raw ACORN-SAT daily temperature data of Rutherglen.

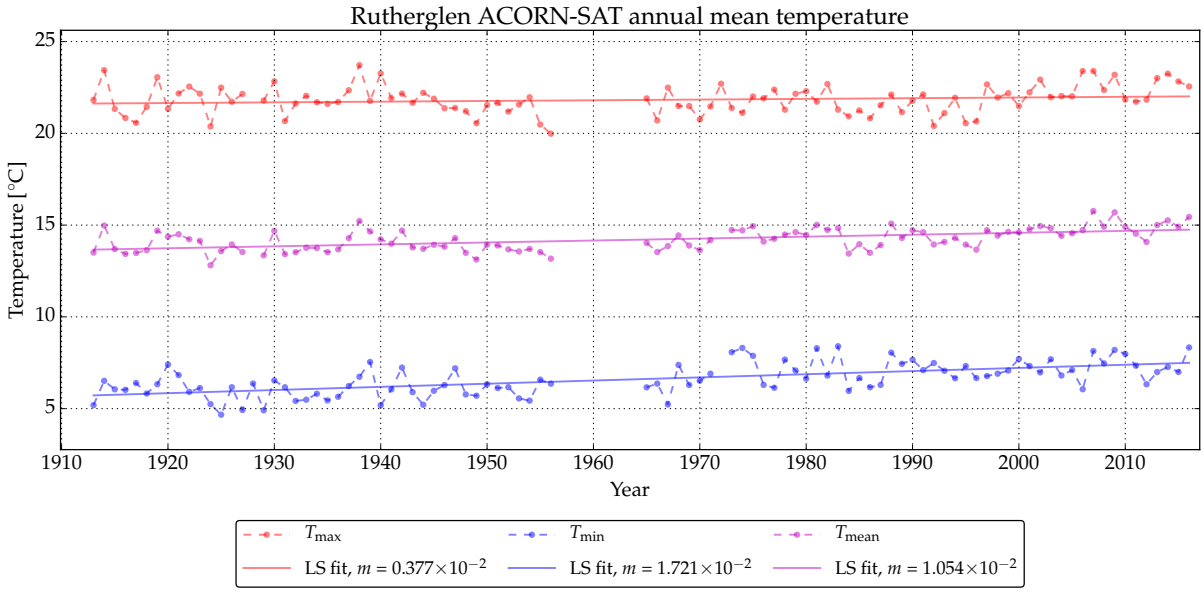

Figure 33: ACORN-SAT annual temperature trends for Rutherglen.

Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

Parameter	Period	Mean (°C)	Standard error	Variance	Slope per century	p-value (t-test)	Nr of samples
T_{max}	1913–2016	21.821	7.911e-02	0.601	0.377	1.424e-01	96
T_{min}	1913–2016	6.610	8.943e-02	0.768	1.721	3.127e-11	96
T_{mean}	1913–2016	14.213	6.167e-02	0.361	1.054	1.043e-08	95

Table 18: Statistical values for Rutherglen ACORN-SAT annual mean temperature

Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/change/acorn-sat/#tabs=Data-and-networks

B.6 Rutherglen CDO record

The results shown in Fig. 34 were obtained using the raw CDO monthly temperature data for Rutherglen.

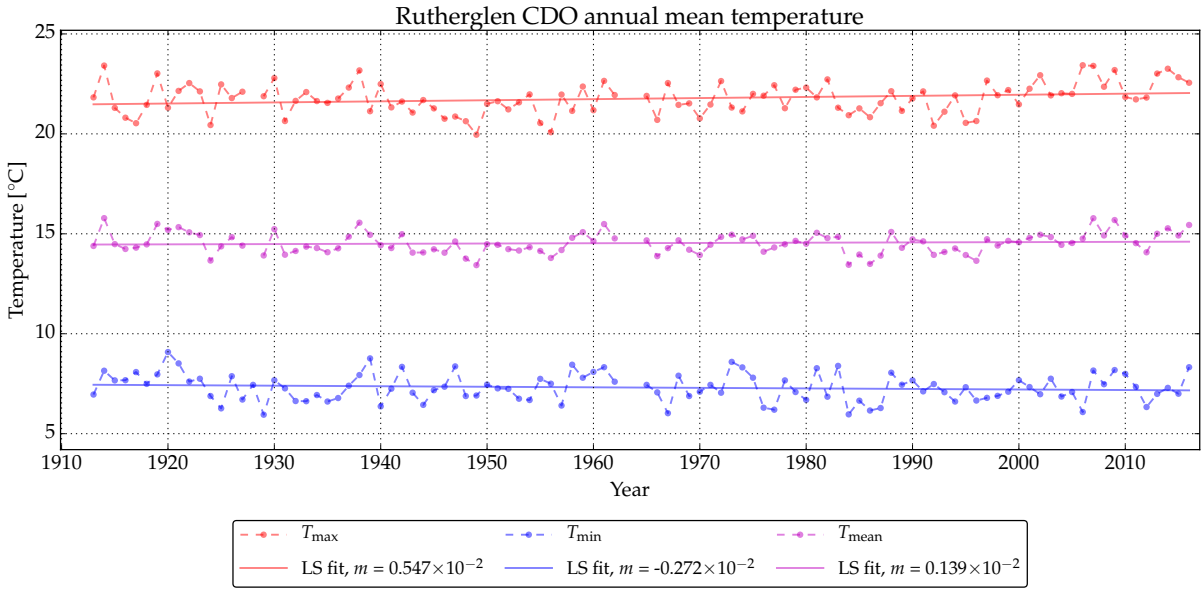

Figure 34: CDO annual temperature trends for Rutherglen.

Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/

Parameter	Period	Mean (°C)	Standard error	Variance	Slope per century	p-value (t-test)	Nr of samples
T_{max}	1913–2016	21.763	7.724e-02	0.603	0.547	3.229e-02	101
T_{min}	1913–2016	7.307	6.810e-02	0.473	-0.272	2.308e-01	102
T_{mean}	1913–2016	14.535	5.074e-02	0.260	0.139	4.139e-01	101

Table 19: Statistical values for Rutherglen CDO annual mean temperature

Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/

C Victorian CDO station ranking

This appendix contains several tables, which show the $T_{\max}$ stations in Victoria ranked according to the number of monthly samples available (*Valid* column). Also shown are the actual start and end dates, the number of years covered (*Span* column) and the associated percentage (number of samples available over the actual period) in the *True %* column, which gives an indication of completeness of the record between the given start and end dates. The number of missing samples (NaN: not a number) and the maximum number of consecutive missing samples are provided in the *NaN (consec)* column. For example, in row 7 (Maryborough) the NaN column indicates 100 (96), meaning there are 100 samples (i.e. months) missing in the record of which the longest run of missing data is 96 consecutive samples.

nr	ID	Station name	Start	End	Span (y)	Valid	NaN (consec)	True %
1	86071	Melbourne Regional Office	1855 May	2015 Jan	160	1917	0 (0)	100.00
2	90015	Cape Otway Lighthouse	1864 Apr	2016 Dec	153	1830	3 (1)	99.84
3	85096	Wilsons Promontory Lighthouse	1877 Mar	2016 Dec	140	1669	9 (5)	99.46
4	84016	Gabo Island Lighthouse	1877 Feb	2016 Dec	140	1647	32 (8)	98.09
5	80015	Echuca Aerodrome	1881 Jun	2016 Dec	135	1624	3 (2)	99.82
6	83025	Omeo Comparison	1879 Jan	2009 Dec	131	1550	22 (9)	98.60
7	88043	Maryborough	1899 Jul	2016 Dec	117	1310	100 (96)	92.91
8	80023	Kerang	1903 Jan	2016 Dec	114	1302	66 (24)	95.18
9	78031	Nhill	1897 Jan	2008 Dec	112	1297	47 (33)	96.50
10	89002	Ballarat Aerodrome	1908 Jan	2016 Dec	109	1292	16 (9)	98.78
11	79023	Horsham Polkemmet Rd	1898 Nov	2012 Apr	113	1239	123 (33)	90.97
12	82039	Rutherglen Research	1912 Nov	2016 Dec	104	1236	14 (12)	98.88
13	82002	Benalla (Shadforth Street)	1903 Jan	2006 Oct	104	1233	13 (7)	98.96
14	77042	Swan Hill Post Office	1899 Sep	1996 Dec	97	1164	4 (4)	99.66
15	90044	Hamilton	1886 Jan	1983 Jun	97	1146	24 (17)	97.95
16	86017	Cape Schanck Lighthouse	1883 Jan	1997 Aug	115	1048	328 (279)	76.16
17	88015	Clunes	1879 Jul	1975 Sep	96	1026	129 (96)	88.83
18	79040	St Arnaud	1896 Sep	1982 Dec	86	1020	16 (10)	98.46
19	82053	Wangaratta	1901 Jan	1987 May	86	1019	18 (7)	98.26
20	90082	Warrnambool (Post Office)	1897 Nov	1983 Apr	85	1008	18 (8)	98.25
21	79028	Longerenong	1891 Jan	2016 Dec	126	983	529 (296)	65.01
22	90147	Colac (Shire Office)	1899 Jan	1983 Apr	84	981	31 (16)	96.94
23	90070	Portland	1863 Jan	1956 Dec	94	961	167 (73)	85.20
24	76047	Ouyen (Post Office)	1937 Feb	2016 Dec	80	959	0 (0)	100.00
25	82001	Beechworth Composite	1908 Jan	1986 Jun	78	932	10 (6)	98.94
26	87021	Durdidwarrah	1903 Jan	2000 Jul	97	928	243 (96)	79.25
27	77004	Beulah	1898 Aug	1975 Sep	77	920	6 (5)	99.35
28	87036	Macedon Forestry	1887 Jan	1999 Sep	113	880	473 (390)	65.04
29	87031	Laverton Raaf	1943 Oct	2016 Dec	73	879	0 (0)	100.00
30	88036	Kyneton Post Office	1887 Jan	1966 May	79	877	76 (55)	92.03
31	85072	East Sale Airport	1945 Aug	2016 Dec	71	857	0 (0)	100.00
32	84030	Orbost (Comparison)	1938 Jan	2011 Nov	74	854	33 (13)	96.28
33	80002	Boort	1907 Jan	1986 Sep	80	849	108 (96)	88.71
34	76031	Mildura Airport	1946 Aug	2016 Dec	70	845	0 (0)	100.00
35	90077	Terang	1897 Apr	1975 Sep	78	842	100 (96)	89.38
36	87054	Queenscliff	1898 Jan	1968 Feb	70	836	6 (3)	99.29
37	76064	Walpeup Research	1939 Jan	2016 Dec	78	811	125 (96)	86.65
38	84080	Bairnsdale Post Office	1896 Jul	1970 Mar	74	808	77 (64)	91.30
39	87025	Geelong Sec	1903 Jan	1970 Jun	67	803	7 (2)	99.14
40	90054	Lorne Post Office	1884 Jan	1955 Apr	71	792	64 (10)	92.52
41	78034	Serviceton	1902 Jan	1971 Sep	70	789	48 (12)	94.27
42	89000	Ararat Post Office	1899 Jan	1969 Apr	70	775	69 (60)	91.82
43	80006	Charlton Post Office	1899 Jan	1971 Sep	73	771	102 (96)	88.32
44	90011	Camperdown (Post Office)	1903 Jan	1975 Aug	73	768	104 (96)	88.07
45	88053	Seymour Shire Depot	1899 Jan	1970 Sep	72	760	101 (96)	88.27
46	77007	Birchip Post Office	1911 Nov	1984 Jan	72	738	129 (96)	85.12
47	80043	Numurkah Post Office	1908 Feb	1977 Jun	69	725	108 (96)	87.03
48	85055	Maffra Forestry Office	1903 Jan	1975 Aug	73	724	148 (96)	83.03
49	87065	Werribee Research Farm	1913 Jan	1980 Jul	67	711	100 (100)	87.67
50	82016	Euroa	1909 Aug	1976 Feb	66	703	96 (96)	87.98

Table 20: VIC station ranking (1 - 50).

Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/

nr	ID	Station name	Start	End	Span (y)	Valid	NaN (consec)	True %
51	86104	Scoresby Research Institute	1948 Jan	2016 Dec	69	702	126 (96)	84.78
52	78011	Donald Post Office	1899 May	1966 Jan	67	696	105 (97)	86.89
53	76077	Mildura Post Office	1889 Jun	1949 Dec	60	695	32 (22)	95.60
54	88109	Mangalore Airport	1959 Jan	2016 Dec	58	693	3 (2)	99.57
55	79042	Stawell	1903 Jan	1969 May	66	674	123 (96)	84.57
56	88041	Maldon (Derby Hill)	1910 Sep	1975 Sep	65	667	114 (96)	85.40
57	83073	Mount Buffalo Chalet	1910 Sep	1980 Apr	70	661	175 (100)	79.07
58	87002	Bacchus Marsh	1898 Aug	1952 Dec	54	646	7 (3)	98.93
59	85133	Sale	1892 Jan	1945 Jul	53	643	0 (0)	100.00
60	86060	Kew	1911 Oct	1973 Jun	62	629	112 (100)	84.89
61	78086	Jeparit	1915 Jul	1975 Sep	60	625	98 (96)	86.45
62	81049	Tatura Inst Sustainable Ag	1965 Jan	2016 Dec	52	624	0 (0)	100.00
63	88001	Alexandra (Post Office)	1910 Nov	1970 Feb	59	609	103 (96)	85.53
64	80091	Kyabram	1965 Jan	2016 Dec	52	607	17 (16)	97.28
65	89018	Lismore (Post Office)	1940 Apr	1994 Mar	54	603	45 (40)	93.06
66	77035	Rainbow Post Office	1912 Apr	1970 Jun	58	602	97 (96)	86.12
67	90135	Casterton Showgrounds	1957 Jan	2011 Feb	54	600	50 (23)	92.31
68	88014	Castlemaine Post Office	1907 Jan	1966 Feb	59	597	113 (96)	84.08
69	89085	Ararat Prison	1969 Jun	2016 Dec	47	571	0 (0)	100.00
70	84070	Point Hicks (Lighthouse)	1966 Jul	2016 Dec	50	568	38 (17)	93.73
71	86038	Essendon Airport	1939 Apr	2016 Dec	78	567	366 (365)	60.77
72	76026	Merbein Csiro Research Station	1920 Jul	1975 Oct	55	566	98 (96)	85.24
73	86127	Wonthaggi	1968 Jul	2016 Dec	48	565	17 (6)	97.08
74	90083	Weeaproinah	1965 Jan	2012 Jan	47	564	1 (1)	99.82
75	88023	Lake Eildon	1970 Mar	2016 Dec	47	562	0 (0)	100.00
76	88110	Castlemaine Prison	1966 Mar	2016 Dec	51	561	49 (32)	91.97
77	86282	Melbourne Airport	1970 Jul	2016 Dec	46	558	0 (0)	100.00
78	86097	Portsea Quarantine Station	1904 Feb	1978 Apr	74	550	341 (192)	61.73
79	86077	Moorabbin Airport	1971 Aug	2016 Dec	45	543	2 (2)	99.63
80	86079	Mornington	1919 Jan	1975 Aug	57	533	147 (72)	78.38
81	88068	Rubicon Sec	1943 Nov	1993 May	49	533	62 (33)	89.58
82	78077	Warracknabeal Museum	1969 Jun	2016 Dec	47	526	45 (24)	92.12
83	86142	Toolangi (Mount St Leonard Dpi)	1953 Jan	2006 Nov	54	522	125 (96)	80.68
84	87005	Ballan (Fiskville)	1927 Nov	1969 Jun	42	493	7 (4)	98.60
85	90048	Heywood Forestry	1950 Jan	2009 Mar	59	487	224 (96)	68.50
86	89050	Ballarat Mount Pleasant Obs.	1890 Mar	1942 Dec	53	485	149 (149)	76.50
87	85048	Leongatha	1897 Feb	1955 Nov	59	483	223 (217)	68.41
88	90014	Cape Nelson Lighthouse Comparison	1957 Jan	1999 Jun	42	482	28 (12)	94.51
89	82042	Strathbogie	1974 Jan	2016 Dec	43	471	45 (26)	91.28
90	82076	Dartmouth Reservoir	1975 Jan	2016 Dec	42	457	47 (40)	90.67
91	84083	Lakes Entrance	1965 Sep	2006 May	41	449	40 (15)	91.82
92	86013	Burnley	1914 Jan	1956 Nov	43	440	75 (66)	85.44
93	85279	Bairnsdale Airport	1943 Apr	2016 Dec	74	432	453 (452)	48.81
94	78042	Wycheproof	1903 Jan	1938 Sep	36	429	0 (0)	100.00
95	90103	Hamilton Research Station	1965 Jan	2000 Jun	35	426	0 (0)	100.00
96	85106	Olsens Bridge (Morwell River Prison)	1951 Dec	1997 Apr	45	426	119 (60)	78.17
97	76038	Murrayville	1915 Apr	1953 Feb	38	420	35 (19)	92.31
98	81003	Bendigo Prison	1957 Jan	1991 Oct	35	417	1 (1)	99.76
99	90171	Portland (Cashmore Airport)	1982 Jun	2016 Dec	34	415	0 (0)	100.00
100	82085	Rutherglen Viticulture College	1903 Jan	1937 May	34	413	0 (0)	100.00

Table 21: VIC station ranking (51 - 100).

Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/

nr	ID	Station name	Start	End	Span (y)	Valid	NaN (consec)	True %
101	78072	Donald	1966 Oct	2000 Oct	34	409	0 (0)	100.00
102	86025	Cowes	1915 Jul	1949 Feb	34	404	0 (0)	100.00
103	86351	Bundoora (Latrobe University)	1979 Sep	2016 Dec	37	401	47 (24)	89.51
104	90173	Hamilton Airport	1983 Jul	2016 Dec	33	398	4 (3)	99.00
105	85280	Morwell (Latrobe Valley Airport)	1984 Jan	2016 Dec	33	394	2 (2)	99.49
106	83023	Mount Beauty	1948 Jan	1994 Jan	46	392	161 (97)	70.89
107	82011	Corryong (Parish Lane)	1972 Feb	2006 Mar	34	387	23 (10)	94.39
108	86082	Mount Eliza	1931 Jan	1973 Jul	42	378	133 (96)	73.97
109	83004	Bogong	1938 Aug	1975 Sep	37	376	70 (60)	84.30
110	83024	Mount Buller	1985 Mar	2016 Dec	32	370	12 (5)	96.86
111	87086	Laverton Explosives	1903 Jan	1934 Mar	31	368	7 (5)	98.13
112	86354	Phillip Island Penguin Reserve	1981 Mar	2016 Nov	36	367	62 (24)	85.55
113	83083	Edi Upper	1985 Nov	2016 Dec	31	356	18 (12)	95.19
114	85103	Yallourn Sec	1957 Jan	1986 Sep	30	356	1 (1)	99.72
115	82138	Wangaratta Aero	1987 May	2016 Dec	30	355	1 (1)	99.72
116	83014	Hotham Heights	1927 Jan	1972 Dec	46	347	205 (130)	62.86
117	86122	Watsonia Loyola	1937 Jan	1973 Dec	37	345	99 (96)	77.70
118	85277	Noojee (Slivar)	1981 Oct	2012 Apr	30	339	28 (23)	92.37
119	87038	Maribyrnong Explosives Factory	1931 Feb	1964 Jul	33	337	65 (60)	83.83
120	86094	Powelltown Dnre	1942 Apr	1978 Jul	36	328	108 (97)	75.23
121	81084	Lemnos (Campbells Soup)	1965 Jan	1996 Jan	31	326	47 (23)	87.40
122	85283	Willow Grove (Blue Rock Reservoir)	1986 Apr	2016 Dec	31	323	46 (22)	87.53
123	82034	Myrtleford Post Office	1927 Oct	1969 Feb	41	322	175 (100)	64.79
124	86375	Cranbourne Botanic Gardens	1990 Feb	2016 Dec	27	316	7 (3)	97.83
125	87117	Geelong (Norlane)	1970 Jun	1996 Jul	26	314	0 (0)	100.00
126	86116	Tooradin	1948 Jul	1974 Oct	26	314	2 (2)	99.37
127	88021	Eberys	1913 Sep	1940 Oct	27	313	13 (8)	96.01
128	79080	Stawell	1969 Jun	1998 Feb	29	309	36 (25)	89.57
129	83084	Falls Creek	1990 Sep	2016 Dec	26	308	8 (4)	97.47
130	85026	Erica	1942 Mar	1975 Sep	33	307	96 (96)	76.18
131	83085	Mount Hotham	1990 Aug	2016 Dec	26	304	13 (13)	95.90
132	81123	Bendigo Airport	1991 Nov	2016 Dec	25	302	0 (0)	100.00
133	90180	Aireys Inlet	1991 Dec	2016 Dec	25	301	0 (0)	100.00
134	86361	Cerberus	1991 Dec	2016 Dec	25	301	0 (0)	100.00
135	90176	Mortlake Racecourse	1991 Dec	2016 Dec	25	301	0 (0)	100.00
136	90175	Port Fairy Aws	1991 Dec	2016 Dec	25	301	0 (0)	100.00
137	86373	Rhyll	1991 Dec	2016 Dec	25	301	0 (0)	100.00
138	87168	Sheoaks	1991 Dec	2016 Dec	25	301	0 (0)	100.00
139	83067	Bright	1969 Jun	1994 Dec	25	300	7 (7)	97.72
140	86371	Frankston Aws	1992 Feb	2016 Dec	25	299	0 (0)	100.00
141	80049	Rochester	1940 Dec	1975 Jul	35	298	118 (96)	71.63
142	84142	Gelantipy	1992 Dec	2016 Dec	24	289	0 (0)	100.00
143	82139	Hunters Hill	1993 Apr	2016 Dec	24	284	1 (1)	99.65
144	84084	Mallacoota	1993 Apr	2016 Dec	24	284	1 (1)	99.65
145	90069	Port Fairy Post Office	1903 Jan	1926 Aug	24	284	0 (0)	100.00
146	88051	Redesdale	1993 Jun	2016 Dec	23	283	0 (0)	100.00
147	81124	Yarrawonga	1993 May	2016 Dec	24	282	2 (2)	99.30
148	85296	Mount Moornapa	1993 Dec	2016 Dec	23	277	0 (0)	100.00
149	88162	Wallan (Kilmore Gap)	1993 Dec	2016 Dec	23	277	0 (0)	100.00
150	85134	Sale Mercury Office	1903 Jan	1926 May	23	273	8 (3)	97.15

Table 22: VIC station ranking (101 - 150).

Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/

nr	ID	Station name	Start	End	Span (y)	Valid	NaN (consec)	True %
151	84143	Combienbar Aws	1994 Jul	2016 Dec	22	270	0 (0)	100.00
152	86383	Coldstream	1994 Oct	2016 Dec	22	267	0 (0)	100.00
153	87113	Avalon Airport	1995 Apr	2016 Dec	22	261	0 (0)	100.00
154	87163	Grovedale (Geelong Airport)	1983 Nov	2011 Jun	28	259	73 (73)	78.01
155	84144	Mount Nowa Nowa	1995 Nov	2016 Dec	21	254	0 (0)	100.00
156	79105	Stawell Aerodrome	1996 Feb	2016 Dec	21	251	0 (0)	100.00
157	90184	Cape Nelson Lighthouse	1995 Dec	2016 Dec	21	250	3 (3)	98.81
158	88164	Eildon Fire Tower	1996 Jul	2016 Dec	20	246	0 (0)	100.00
159	81125	Shepparton Airport	1996 Jul	2016 Dec	20	246	0 (0)	100.00
160	82038	Rutherglen Post Office	1903 Jan	1925 Jun	22	245	25 (25)	90.74
161	86147	Aspendale Csiro	1954 Jan	1982 Jun	28	242	100 (96)	70.76
162	77094	Swan Hill Aerodrome	1996 Dec	2016 Dec	20	241	0 (0)	100.00
163	86372	Ferny Creek (Dunns Hill)	1991 Dec	2011 Jul	20	236	0 (0)	100.00
164	79100	Horsham Aerodrome	1997 Oct	2016 Dec	19	231	0 (0)	100.00
165	83033	Woods Point	1950 Aug	1969 Sep	19	230	0 (0)	100.00
166	85291	Mount Baw Baw	1997 Aug	2016 Dec	19	221	12 (7)	94.85
167	84028	Nowa Nowa	1948 Nov	1975 Aug	27	220	102 (97)	68.32
168	90186	Warrnambool Airport Ndb	1998 Oct	2016 Dec	18	219	0 (0)	100.00
169	90040	Forrest State Forest	1949 Jan	1975 Aug	27	218	102 (97)	68.12
170	82100	Bonegilla	1968 Jun	1986 Jun	18	217	0 (0)	100.00
171	86243	Mount Dandenong Gtv9	1968 Jan	1986 Jun	18	217	5 (5)	97.75
172	86050	Healesville (Badger Crk Sanctuary)	1927 Jul	1990 Sep	63	213	546 (408)	28.06
173	83020	Mansfield 2	1883 May	1901 Jan	18	213	0 (0)	100.00
174	85098	Yallourn	1932 May	1949 Dec	18	211	1 (1)	99.53
175	85093	Warragul	1962 Jan	1979 Dec	18	210	6 (6)	97.22
176	88019	Creswick	1949 Mar	1975 Sep	26	208	111 (96)	65.20
177	90172	Warrnambool Airport	1983 Mar	2000 Jun	17	208	0 (0)	100.00
178	86068	Viewbank	1999 Nov	2016 Dec	17	206	0 (0)	100.00
179	88104	Talbot	1903 Jan	1920 Jul	17	205	6 (4)	97.16
180	85079	Tanjil Bren	1943 Mar	1971 Aug	28	204	138 (96)	59.65
181	85240	Ellinbank Dairy Research Inst	1983 Aug	2000 Aug	17	203	2 (2)	99.02
182	90134	Gellibrand River Forestry	1965 Jan	1981 Oct	17	202	0 (0)	100.00
183	89036	Woohlpooer	1949 Feb	1975 Aug	26	201	118 (96)	63.01
184	90035	Colac (Mount Gellibrand)	2000 Jul	2016 Dec	16	198	0 (0)	100.00
185	85051	Loch Valley Plantation	1940 Jan	1956 Aug	17	198	2 (1)	99.00
186	90148	Lorne Pier Head	1969 Dec	1986 Apr	16	197	0 (0)	100.00
187	84145	Orbost	2000 Nov	2016 Dec	16	194	0 (0)	100.00
188	90001	Apollo Bay	1906 Aug	1924 Jul	18	192	24 (6)	88.89
189	86190	Mentone	1914 Nov	1931 Jul	17	192	9 (3)	95.52
190	85078	Stratford	1903 Jan	1919 Oct	17	189	13 (4)	93.56
191	90174	Colac (Elliminyt)	1983 May	1998 Oct	15	186	0 (0)	100.00
192	89105	Lookout Hill	1991 Dec	2007 Apr	15	181	4 (4)	97.84
193	84027	Cann River Forestry	1951 Mar	1973 Dec	23	177	97 (96)	64.60
194	87166	Point Wilson	1994 Feb	2008 Sep	15	176	0 (0)	100.00
195	90092	Rennick	1952 Nov	1975 Sep	23	175	100 (97)	63.64
196	82056	Wodonga	1954 Mar	1968 May	14	170	1 (1)	99.42
197	86033	Brighton Bowls Club	1946 May	1967 Nov	21	163	96 (96)	62.93
198	78015	Nhill Aerodrome	2003 Jun	2016 Dec	13	163	0 (0)	100.00
199	86007	Black Rock	1941 Jan	1954 Jun	13	162	0 (0)	100.00
200	86178	Greenvale Sanatorium	1913 May	1948 Jun	35	158	264 (173)	37.44

Table 23: VIC station ranking (151 - 200).

Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/

nr	ID	Station name	Start	End	Span (y)	Valid	NaN (consec)	True %
201	79097	Kanagulk	2004 May	2016 Dec	13	152	0 (0)	100.00
202	84108	Bairnsdale	1970 Apr	1983 Jun	13	151	8 (7)	94.97
203	77010	Hopetoun Airport	2004 Jun	2016 Dec	12	151	0 (0)	100.00
204	80128	Charlton	2004 Jul	2016 Dec	12	150	0 (0)	100.00
205	80101	Numurkah	1977 Jul	1992 Apr	15	149	29 (29)	83.71
206	83090	Omeo	2004 Aug	2016 Dec	12	149	0 (0)	100.00
207	85199	Moondarra Reservoir	1974 Jan	1988 Feb	14	146	24 (18)	85.88
208	90182	Casterton	2005 Mar	2016 Dec	12	142	0 (0)	100.00
209	79099	Edenhope Airport	2005 Apr	2016 Dec	12	141	0 (0)	100.00
210	83081	Mount Hotham	1977 Dec	1990 Jul	13	139	13 (11)	91.45
211	86224	Dandenong	1962 Jan	1974 Nov	13	138	17 (13)	89.03
212	82137	Beechworth Woolshed	1986 Nov	2012 Apr	25	135	171 (36)	44.12
213	79103	Grampians (Mount William)	2005 Dec	2016 Dec	11	133	0 (0)	100.00
214	89112	Westmere	2006 Feb	2016 Dec	11	131	0 (0)	100.00
215	82169	Corryong Airport	2006 Mar	2016 Dec	11	130	0 (0)	100.00
216	81013	Dookie Agricultural College	1965 Jan	1975 Oct	11	130	0 (0)	100.00
217	81057	Yarrawonga Post Office	1965 Jan	1975 Sep	11	129	0 (0)	100.00
218	81000	Avoca (Post Office)	1965 Jan	1975 Aug	11	128	0 (0)	100.00
219	84150	Lakes Entrance (Eastern Beach Road)	2006 Jun	2016 Dec	10	127	0 (0)	100.00
220	88153	Spring Creek Basin Two	1973 Dec	1984 Jun	10	127	0 (0)	100.00
221	86306	Stony Point	1972 Aug	1983 Feb	10	123	4 (4)	96.85
222	82170	Benalla Airport	2006 Nov	2016 Dec	10	122	0 (0)	100.00
223	89094	Warrambine Basin No 3	1972 Mar	1982 May	10	122	1 (1)	99.19
224	85153	Noojee	1965 Jun	1975 Sep	10	121	3 (3)	97.58
225	81115	Wanalta Daen Station	1974 Aug	1984 Jun	10	119	0 (0)	100.00
226	86161	Brighton Middle	1899 Oct	1909 Jun	10	117	0 (0)	100.00
227	85099	Pound Creek	2007 Apr	2016 Dec	10	117	0 (0)	100.00
228	82068	Mitta Mitta	1953 Oct	1972 Feb	18	116	105 (96)	52.49
229	85227	East Tarwin (Mirboo Pastoral Company)	1975 Jan	1984 Jun	9	114	0 (0)	100.00
230	82066	Corryong Forestry	1953 Dec	1972 Jan	18	111	107 (96)	50.92
231	85298	East Sale Comparison	1996 Jun	2005 Aug	9	111	0 (0)	100.00
232	85151	Yarram Airport	2007 Oct	2016 Dec	9	111	0 (0)	100.00
233	79101	Pyrenees (Ben Nevis)	2007 Dec	2016 Dec	9	109	0 (0)	100.00
234	78045	Wail	1952 Feb	1969 Jun	17	108	101 (84)	51.67
235	86364	Tarrawarra Monastery	1986 Dec	1997 Apr	10	107	18 (6)	85.60
236	76125	Robinvale Consolidated School	1970 Dec	1980 Feb	9	106	5 (2)	95.50
237	90162	Portland Aero	1973 Oct	1982 Jun	9	105	0 (0)	100.00
238	85152	Won Wron Prison	1967 Feb	1975 Sep	9	103	1 (1)	99.04
239	87023	Geelong Salines (Moolap)	1951 Jun	1967 Aug	16	99	96 (96)	50.77
240	87159	Blackwood (Armstrong)	1974 Dec	1982 Dec	8	96	1 (1)	98.97
241	86245	Carrum Downs	1967 Dec	1975 Oct	8	95	0 (0)	100.00
242	90194	Dartmoor	2009 Mar	2016 Dec	8	94	0 (0)	100.00
243	82050	Wahgunyah Nursery	1925 Jan	1932 Oct	8	91	3 (2)	96.81
244	81044	Goulburn River @ Shepparton	1965 Jan	1972 Jun	7	90	0 (0)	100.00
245	90129	Warrnambool (Fawsyde)	1915 Jan	1921 Dec	7	84	0 (0)	100.00
246	88123	Kyneton	1969 Jul	1976 Feb	7	80	0 (0)	100.00
247	85057	Maryvale	1950 Jan	1956 Nov	7	79	4 (1)	95.18
248	82052	Walwa	1912 Jan	1918 Mar	6	75	0 (0)	100.00
249	84058	Kowat	1929 Jan	1935 Feb	6	74	0 (0)	100.00
250	80092	Wyuna	1913 Jan	1918 Dec	6	72	0 (0)	100.00

Table 24: VIC station ranking (201 - 250).

Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/

nr	ID	Station name	Start	End	Span (y)	Valid	NaN (consec)	True %
251	87092	Teesdale	1903 Jan	1913 Dec	11	71	61 (61)	53.79
252	90007	Beech Forest State Forest	1949 Jan	1956 Apr	7	70	18 (7)	79.55
253	86266	Ferny Creek	2011 Mar	2016 Dec	6	70	0 (0)	100.00
254	88029	Heathcote	1969 Aug	1975 Sep	6	70	4 (2)	94.59
255	90192	Portland Ntc Aws	2011 Apr	2016 Dec	6	69	0 (0)	100.00
256	82092	Shelley	1965 Jan	1972 Jan	7	69	16 (6)	81.18
257	82059	Stanley State Forest	1952 Nov	1966 Jun	14	68	96 (96)	41.46
258	84087	Tabberabbera (The Pines)	1974 Apr	1980 Jun	6	68	7 (6)	90.67
259	87184	Breakwater (Geelong Racecourse)	2011 Jun	2016 Dec	5	67	0 (0)	100.00
260	86240	French Island (Mcleod Prison)	1969 Oct	1975 Apr	5	67	0 (0)	100.00
261	88009	Cairn Curran Reservoir	1951 Jan	1956 Dec	6	66	6 (3)	91.67
262	87032	Laverton Salines	1951 Apr	1965 Apr	14	65	104 (97)	38.46
263	85000	Aberfeldy	1969 Sep	1974 Oct	5	61	1 (1)	98.39
264	79001	Apsley	1903 Jan	1907 Dec	5	60	0 (0)	100.00
265	86155	Camberwell 1	1903 Jan	1907 Dec	5	60	0 (0)	100.00
266	78010	Dimboola	1903 Jan	1907 Dec	5	60	0 (0)	100.00
267	83037	Falls Creek Sec	1974 Apr	1990 Sep	16	60	138 (130)	30.30
268	86085	Narre Warren North (Narre Warren North	1903 Jan	1907 Dec	5	59	1 (1)	98.33
269	86221	Sherbrooke Burnam Beeches	1957 May	1961 Dec	5	56	0 (0)	100.00
270	85142	Warragul (Naringa)	1912 Aug	1917 Aug	5	53	8 (3)	86.89
271	85301	Corner Inlet (Yanakie)	2013 Jan	2016 Dec	4	48	0 (0)	100.00
272	85082	Tidal River	1965 Jul	1972 Jan	6	48	31 (28)	60.76
273	89001	Ballarat Botanical Gardens	1904 Mar	1907 Dec	4	44	2 (2)	95.65
274	86338	Melbourne (Olympic Park)	2013 Jun	2016 Dec	3	43	0 (0)	100.00
275	86344	South Channel Island	1998 Dec	2002 Jul	4	40	4 (4)	90.91
276	85269	Noojee Pearce	1978 Jul	1981 Oct	3	39	1 (1)	97.50
277	88111	Malmsbury	1966 Jul	1969 Jun	3	36	0 (0)	100.00
278	85313	Nilma North (Warragul)	2014 Jan	2016 Dec	3	36	0 (0)	100.00
279	85235	East Tarwin No.18	1972 May	1974 Dec	3	32	0 (0)	100.00
280	84077	Bendoc Forestry	1965 Jan	1967 Sep	3	31	2 (2)	93.94
281	80099	Serpentine Loddon Valley H'Way	1969 Apr	1971 Sep	2	29	1 (1)	96.67
282	85150	Hazelwood Sec	1965 Jan	1967 Apr	2	28	0 (0)	100.00
283	88133	Newbury	1972 Jun	1974 Aug	2	27	0 (0)	100.00
284	89092	Warrambine No 2	1982 Jun	1984 Aug	2	27	0 (0)	100.00
285	86384	Melbourne Airport Comparison	1999 Aug	2001 Aug	2	25	0 (0)	100.00
286	90022	Colac Airport	1998 Oct	2000 Aug	2	23	0 (0)	100.00
287	90169	Hamilton Godfrey	1980 Jul	1981 Nov	1	17	0 (0)	100.00
288	86368	Dalmore	1988 Jun	1990 Aug	2	15	12 (12)	55.56
289	87177	Laverton Comparison	1997 Jun	1998 Jul	1	14	0 (0)	100.00

Table 25: VIC station ranking (240 - 289).

Source: Australian Bureau of Meteorology website at http://www.bom.gov.au/climate/data/

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